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FEDERAL AVIATION ADMINISTRATION WASHINGTON DC OFFICE--ETC F/G 5/4  
SUMMARY OF FEDERAL AVIATION ADMINISTRATION RESPONSES TO NATIONAL--ETC(U)  
JAN 82 J H MACKINNON, C A CARPENTER

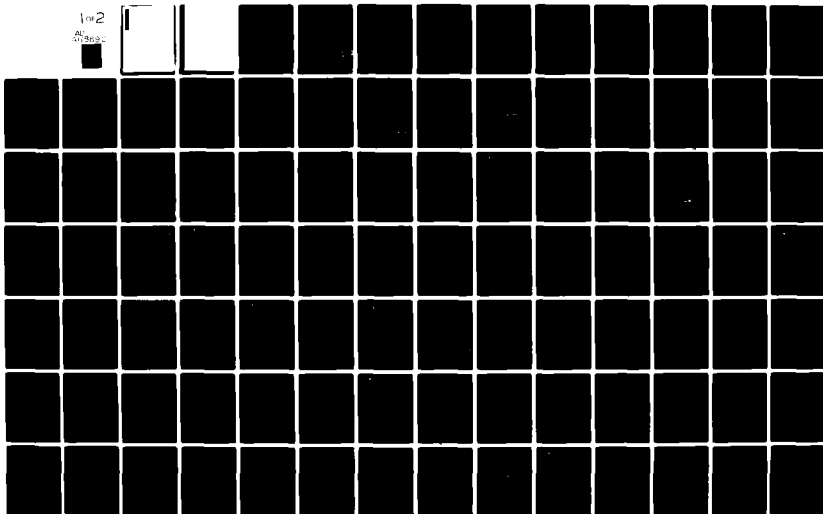
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August 24, 1982

Report No. FAA-ASF-82-1 - Quarterly Report January thru March 1982

Title: Summary of Federal Aviation Administration Responses to National  
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16. Abstract <p>This report contains NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions.</p> <p>The Table of Contents for this report reflects only those NTSB recommendations which are still open pending FAA action (i.e., those that have not been designated as "Closed" by the NTSB as a result of acceptable action). Accordingly, the Table of Contents may reflect a number of multiple recommendations (example: (A-81-139 through 143), but background material is included only for those recommendations which remain in an "Open" status. Background information for those recommendations which have been closed is available in FAA Headquarters files.</p>			
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## FOREWORD

The National Transportation Safety Board as established by Public Law 93-633, Title III, "Independent Safety Board Act of 1974," has among its duties the requirement to "... issue periodic reports to the Congress, federal, state, and local agencies concerned with transportation safety, and other interested persons recommending and advocating meaningful responses to reduce the likelihood of recurrence of transportation accidents and proposing corrective steps."

The Act specifies that whenever the Board submits a recommendation regarding transportation safety to the FAA, or other agencies of the Department of Transportation, that the agency shall respond to each such recommendation formally and in writing not later than 90 days after receipt thereof. The Act also requires that the response to the Board shall indicate the agency's intention to initiate adoption of the recommendation in full or in part, or to refuse to adopt such recommendation, in which case the response shall set forth in detail the reasons for the refusal.

A notice of each recommendation and the receipt of a response from the agency is published in the Federal Register. There is no requirement to publish either the recommendation or the response in its entirety.

The Federal Aviation Administration places a high priority on the evaluation of the Board's investigation and its recommendations. In recognition of the importance of these recommendations and the responses, the FAA, beginning with the first quarter of calendar year 1980, publishes quarterly reports of NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions.

The NTSB system of priority classification for action provides for documented NTSB followup action for each safety recommendation in accordance with one of the following classifications:

1. Class I - Urgent Action: Urgent commencement and completion of action is mandatory to avoid imminent loss of life or injury and/or extensive property loss.
2. Class II - Priority Action: Priority commencement of action is necessary to avoid probable loss of life or injury and/or property loss.
3. Class III - Longer-Term Action: Routine action is necessary so that possible future injury and loss of life and property may be avoided.



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The purpose of this publication is to provide a systematic quarterly update and summation of NTSB Safety Recommendations and FAA actions and reponses. This document is intended to keep the public abreast of NTSB and FAA efforts in the area of aviation safety for the applicable quarter covered by the report.

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## SUMMARY

Statistics for CY 1981 included:

169 new recommendations issued to FAA.

137 recommendations officially "Closed" during this period.

The following exchanges of NTSB/FAA correspondence concerning NTSB Safety Recommendations occurred during the first quarter, January through March 31, 1982.

- o FAA initial responses to NTSB recommendations: 7 letters involving 25 recommendations.
- o FAA letters to NTSB discussing reconsideration of earlier responses, current status, or followup actions: 6 letters involving 18 recommendations.
- o FAA "final report" letters to NTSB: 9 letters involving 21 recommendations.

Officially "Closed" by the NTSB during this quarter: 9 recommendations.

There was one FAA response to six Class I--Urgent Action recommendations during this quarter.

<u>Accident Date</u>	<u>Recommendation Number</u>	<u>Issue Date</u>	<u>Response Date</u>
1/13/82	A-82-6, 7, 8, 9, 10 and 15	1/28/82	2/22/82

### FAA Action

A telegraphic message was transmitted to all air carrier operators and manufacturers. We conducted a telephone conference to advise regional flight standards personnel to contact all air carriers, to review the Board's safety recommendations and each operators' respective cold weather operational procedures, training programs, and contents of their operations manuals, as requested by the Board. A survey report indicated that all air carriers have been contacted and made aware of the safety recommendations and hazards associated with icing. An Air Carrier Operations Bulletin will be issued to the aircrews emphasizing the use of engine anti-ice. An R&D effort is underway. A GENOT was issued.

The FAA response to Class I - Urgent Action recommendations is reflected in the following summary:

A-82-6 through 10 and A-82-15

On January 13, 1982, Air Florida Flight 90, a Boeing 737-222(N62AF) crashed in moderate to heavy snowfall and low visibility at 1601 e.d.t. shortly after departing runway 36, at Washington National Airport, Washington, D.C. The aircraft failed to achieve a sufficient rate of climb, struck the 14th Street Bridge about 4,500 feet from the departure end of the runway, and crashed into the Potomac River. Four persons in automobiles on the bridge were killed when the vehicles were struck by the descending aircraft. Seventy-four of the 79 persons aboard the aircraft were killed either on impact or by drowning.

A weather observation taken within 15 minutes after the accident indicated that the visibility was 3/8 mile in snow, the temperature and dewpoint were both 24 degrees, and the wind was 020° at 13 knots. The investigation data to date shows that about 45 minutes had elapsed between the final deicing of the aircraft's aerodynamic surfaces with an ethylene glycol/water solution and the takeoff. During the 45-minute period, an additional 0.7 to 1.0 inch of snow had accumulated. Therefore, the continuing investigation is focusing on, among other factors, those which could have affected the aircraft's takeoff and climb performance. These will include the effect of a runway contaminated by snow or slush on takeoff acceleration, the extent to which aerodynamic lift is degraded by contaminated airfoils, and the possible effects of engine nacelle and pressure probe icing.

Accordingly, the NTSB directed the following Urgent Action Recommendation to the FAA:

- A-82-6. Immediately notify all air carrier operators of the potential hazard associated with engine inlet pressure probe icing, and require that they provide flightcrews with information on how to recognize this hazard and require that flightcrews cross-check all engine instruments during the application of takeoff power.
- A-82-7. Immediately review the predeparture deicing procedures used by all air carrier operators engaged in cold weather operations and the information provided to flightcrews to emphasize the inability of deicing fluid to protect against reicing resulting from precipitation following deicing.
- A-82-8. Immediately review the information provided by air carrier operators to flightcrews engaged in cold weather operations to ensure comprehensive coverage of all aspects of such operations, including the effects of a runway contaminated by snow or slush on takeoff, and methods to be used to obtain maximum effectiveness of engine anti-ice during ground operations and takeoffs.
- A-82-9. Immediately require flightcrews to visually inspect wing surfaces before takeoff if snow or freezing precipitation is in progress and the time elapsed since either deicing or the last confirmation that surfaces were clear exceeds 20 minutes to ensure compliance with 14 CFR 121.629(b) which prohibits takeoff if frost, snow or ice is adhering to the wings or control surfaces.

- A-82-10. Immediately issue a General Notice (GENOT) to all FAA tower and air carrier ground control personnel alerting them to the increased potential for aircraft icing during long delays before takeoff and when aircraft operate in proximity to each other during ground operations in inclement weather, and encouraging procedural changes where possible so that the controllers implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, paragraph 1232.
- A-82-15. Immediately disseminate the contents of this safety recommendation letter to foreign operators involved in cold weather operations.

The Federal Aviation Administration (FAA) initiated immediate action upon receipt of the NTSB Urgent Action Recommendations. With regard to Safety Recommendations A-82-6 through -8, and A-82-15, a telegraphic message was transmitted on January 28, 1982, to all FAA facilities; U.S. air carriers; U.S. owners, operators, aircraft and engine manufacturers; foreign authorities of known airplane registration; and other interested groups. This notice contained the verbatim contents of the Board's safety recommendation letter issued and transmitted to the FAA on January 28. The purpose of the transmittal to all air carrier operators and manufacturers was to ensure their awareness of the preliminary findings and recommendations as requested by the Board.

A telephone conference (telecon) was conducted on January 29 involving FAA headquarters and all FAA regional flight standards division personnel. The telecon was initiated to advise regional flight standards personnel to contact all air carriers, with the emphasis on operators of turbine-powered aircraft, to review the Board's safety recommendations and each operator's respective cold weather operational procedures, training programs, and contents of their operations manuals, as requested by the Board.

A survey report has been provided by each FAA region. This report indicates that all air carriers have been contacted and made aware of the safety recommendations and hazards associated with icing.

In addition, an Air Carrier Operation Bulletin (ACOB) No. 7-82-2, was issued on March 11, 1982. This cold weather operations bulletin emphasized to aircrews the appropriate use of engine anti-ice.

- A-82-9. Immediately require flight crews to visually inspect wing surfaces before takeoff if snow or freezing precipitation is in progress and the time elapsed since either deicing or the last confirmation that surfaces were clear exceeds 20 minutes to ensure compliance with 14 CFR 121.629(b) which prohibits takeoff if frost, snow or ice is adhering to the wings or control surfaces.

The FAA advised the Safety Board that a reference to a time such as 20 minutes since deicing or the last confirmation that the aircraft surfaces were clear is not considered in the best interest of flight safety. Under some atmospheric conditions, ice may form in a much shorter period whether ground deicing has been performed or not. Flightcrews must use the "clear

aircraft" concept specified by current rules without regard to specific time intervals. Our rationale for this position is as follows:

1. Operators use various deicing fluids and strengths and use various application procedures resulting in differing characteristics.
2. Deicing fluid life is dependent upon many variables such as the type of fluid used, fluid strength, residual moisture on the surface being treated, etc.
3. Under some atmospheric conditions, "dry" snow may become wet snow, melt and refreeze on warm surfaces, such as fuel tank areas, engine nacelles and areas heated by anti-icing systems, even if the aircraft was not deiced. Further, glycol deiced surfaces can turn "dry" snow into "wet" snow. Emphasis should be placed on visual inspection regardless of whether or not deicing has occurred, or when it has occurred.
4. Under some atmospheric conditions, ice or interfacial slush can form on one side of the aircraft while the other side is being sprayed.
5. Stating a specific time interval may mislead the flightcrew into not performing a needed pre-takeoff inspection.

A study was initiated in February 1981, to determine the effectiveness of ethylene glycol-based deicing fluid concentrations as an anti-icing agent under differing icing and snow conditions. As a result of the initial phase of this effort, it was concluded that:

1. Deicing fluids in use today should not be considered to have anti-icing qualities during precipitation. This is the basis of requirements set forth in 14 CFR, Sections 121.629, 91.209, and 135.227, which are commonly referred to as the clean aircraft concept.
2. The only method of assuring that the deicing process has been effective and that the aircraft is clean of adhering ice, snow, or frost formations, is by close inspection just prior to takeoff.
3. A test program to ascertain the effectiveness of deicing fluid strictly as an anti-icing agent does not appear productive at this time because of the many operational variables that could invalidate finite results. Specifying an interval between "deicer" application and takeoff could detract from the clean aircraft concept. However, there is merit in determining if advisory material could be developed.

The second phase of our effort includes:

1. Review of current U.S. air carrier ground deicing and inspection procedures and guidelines.
2. Review of recent studies on the effects of ice and frost formations on aircraft performance, stability and control.

3. Development of additional advisory information as necessary.

Since the Air Florida Flight 90 accident of January 13, 1982, the FAA accelerated this phase because of the need to compile data and information relevant to the accident and to initiate review of current ground deicing procedures.

As a result of efforts to date, it has been determined that limited testing is needed, and planning is in progress to:

1. Verify analytical and empirical estimates of ice/snow formations under various atmospheric conditions combined with different deicing mixtures.
2. Verify analytical techniques for estimation of fluid film thickness as a function of selected variables.

Additional R&D needs may be defined as the program progresses. A report containing the results of these efforts is scheduled to be complete in October 1982.

A-82-10. Immediately issue a General Notice (GENOT) to all FAA tower and air carrier ground control personnel alerting them to the increased potential for aircraft icing during long delays before takeoff and when aircraft operate in proximity to each other during ground operations in inclement weather, and encouraging procedural changes where possible so that the controllers implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, paragraph 1232.

The FAA advised the Safety Board that a copy of NTSB Recommendations A-82-6 through -15 was sent in its entirety to all air traffic facilities in GENOT form on January 28, as mentioned above. We believe the provisions of FAA Facilities Operations and Administration Manual 7210.3F, paragraph 1232, gate-hold procedures, adequately cover the handling of departure procedure delays. The GENOT of January 28 acts to remind facilities to review their application of these procedures.



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave., S W  
Washington, D.C. 20591

January 5, 1982

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-139 through A-81-143 issued by the Board on October 6, 1981. These recommendations resulted from a study conducted by the Board entitled "Special Study: Cabin Safety in Large Transport Aircraft" (NTSB-AAS-81-2). According to the study, since 1970 almost 60 percent of the large transport aircraft involved in survivable and partially survivable major accidents and incidents investigated by the Safety Board have exhibited failures of cabin furnishings. Of the more than 4,800 passengers and crew involved in these accidents, over 1,850 were injured or killed. The Safety Board believes that many of these injuries and deaths would have been prevented had cabin furnishings not failed, particularly in accidents involving fire (about 46 percent).

The regulations dealing with the ability of an aircraft to withstand crash forces are found in two different subparts of 14 CFR 25 - Airworthiness Standards: Transport Category Airplanes. For cabin crashworthiness and occupant protection, the specific regulations are 14 CFR 25.561, Emergency Landing Conditions—General; 14 CFR 25.785, Seats, berths, safety belts, and harnesses; 14 CFR 25.787, Stowage compartments; and 14 CFR 25.789, Retention of items of mass in passenger and crew compartments and galleys.

The Safety Board believes that there is sufficient data currently available to support the upgrading of the occupant crash protection standards in the regulations. The Safety Board also believes that the FAA should concentrate research efforts on applying available technology to transport aircraft, and in newer areas, such as crashworthiness of composites.

The concerns expressed in the discussions which preface Safety Recommendations A-81-139 through 142 are not new or unique. On July 2, 1980, the FAA announced a public meeting to discuss the adequacy of the strength requirements for seats and seat restraints in transport category airplanes. The public meeting was held July 30-31, 1980, in Washington, D.C., at which time much testimony on the subject was heard. In addition, Docket No. 20503 was held open until October 17, 1980, to allow further submissions for the record. The FAA made a

review of the public meeting transcript and docket material and found that inadequate information and data existed at that time to initiate specific rulemaking action. A more thorough discussion of our finding is contained in the enclosed denial of the Institute for Public Interest Representation petition.

The NTSB was a participant in the aforementioned meeting and is aware of the disposition of the items of discussion. Recommendations A-81-139 through 142 address many of the same items discussed in that public meeting. Further information and data have not been submitted by the NTSB to justify the direction or validate the appropriateness of the subject recommendations. In addition, the Board has not demonstrated that the benefits to society outweigh the potential cost of the recommended actions.

The NTSB report has not been made available to the FAA; however, review of a draft copy finds that 77 accidents were used to establish the statistics, conclusions, and recommendations. The subject NTSB report itself identifies and provides case histories of only 5 of the 77 accidents. We would be pleased if the NTSB would provide us with the following so that we may evaluate and appropriately comment on the report, and more properly take action with respect to the report and its recommendations.

1. A list of all 77 accidents used in the study.
2. Case histories, in rough draft form if necessary, for the 72 accidents not discussed in the report.
3. A copy of the Human Factors Report on each of the 77 accidents.

Comment concerning the individual recommendations follow herein:

With specific regard to Safety Recommendations A-81-139, A-81-140, A-81-141, A-81-142, and A-81-143 issued by the Board on October 6, 1981, I am in the process of conducting a detailed technical review of each of the projects currently underway which deal with the substance of those recommendations. This review is being conducted as expeditiously as possible without glossing over the many important but subtle technical details involved. I will be happy to keep the Board informed of any significant progress made in these areas and expect to provide more specific details on my decision in each of these areas in the very near future.

A special committee of the Aerospace Industries Association, on behalf of its large transport aircraft manufacturers, submitted the enclosed comments on December 18, 1981, regarding the aforementioned safety recommendations on cabin

cabin safety. Because of the economic impact of implementing these safety recommendations, it is important that the industry have a voice in our actions. We trust you will consider these industry comments along with those of the FAA.

Sincerely,

  
J. Lynn Helms  
Administrator

Enclosures

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: October 6, 1981

Forwarded to:  
Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
800 Independence Avenue, S.W.  
Washington, D.C. 20591

**SAFETY RECOMMENDATION(S)**

**A-81-139 through -143**

A study 1/ by the National Transportation Safety Board has shown that since 1970, almost 60 percent of the large transport aircraft involved in survivable and partially survivable major accidents and incidents investigated by the Safety Board have exhibited failures of cabin furnishings. Of the more than 4,800 passengers and crew involved in these accidents, over 1,850 were injured or killed. The Safety Board believes that many of these injuries and deaths would have been prevented had cabin furnishings not failed, particularly in accidents involving fire (about 46 percent).

The regulations dealing with the ability of an aircraft to withstand crash forces are found in two different subparts of 14 CFR 25- Airworthiness Standards: Transport Category Airplanes. For cabin crashworthiness and occupant protection, the specific regulations are 14 CFR 25.561, Emergency Landing Conditions--General; 14 CFR 25.785, Seats, berths, safety belts, and harnesses; 14 CFR 25.787, Stowage compartments; and 14 CFR 25.789, Retention of items of mass in passenger and crew compartments and galleys.

Regulation 14 CFR 25.561, which is the foundation for the other three regulations, has not been upgraded in about 30 years. Although design and testing technology have improved greatly, no changes have been made. The Safety Board believes that the fact that crashworthiness is treated in separate subparts of 14 CFR 25 and not in one consolidated section may have contributed to the lack of progress in this extremely important area.

The Safety Board does not believe that occupants of large transport aircraft are protected adequately in a minor crash landing. This study has shown that aircraft occupants are being injured, trapped, and killed in survivable accidents. Many deaths and injuries are directly attributable to failures of seats and cabin furnishings. After falling, seat systems and other cabin furnishings trap and incapacitate occupants or become obstacles to rapid egress, thereby increasing greatly the potential for fatalities caused by postcrash factors. However, most of these accidents involved

1/ For more information read, "Special Study: Cabin Safety in Large Transport Aircraft," (NTSB-AAS-81-2)

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forces greater than those specified in 14 CFR 25.561. For these cases, the failures are to be expected, even if the minimum standards for design are met. For this reason it is the belief of the Safety Board that 14 CFR 25.561 does not represent adequately the actual accident experience of transport aircraft and that because of this, the passengers and crew are not receiving protection in survivable and partially survivable crashes where it is most needed.

As this study has shown, there is ample evidence from accident cases as well as research to show that human tolerance levels are significantly greater than the FAA officially maintains. The evidence includes a substantial body of work done within the FAA itself. Recognizing that human tolerance limits are considerably higher than the load limits cited in 14 CFR 25.561, two other factors become apparent. First, the current fuselage structures are doing a relatively good job of protecting occupants in crashes with large forces. Second, the limiting factor for survival in these crashes is not human tolerance limits; instead, it is the lethal nature of the environment inside the fuselage.

Many factors, such as aircraft velocity and attitude at impact, affect the loads on an aircraft and ultimately its passengers. The accident cases presented in this study have shown that crash environments are extremely complex and always changing. Forces acting on the aircraft and its interior do not act separately, but in combinations. Therefore, the Safety Board has advocated the use of dynamic testing of items in the tiedown chain and other items of mass in the aircraft cabin. The Aircraft Crash Survival Design Guide 2/ describes methods for multiaxis dynamic testing of seat/restraint systems and improved methods for static testing of these systems. Simula Inc. has adapted these methods for different categories of transport aircraft. 3/ The Safety Board believes that this is the best method currently available for dynamic testing, because it involves the components of the seat system reacting together under conditions in which forces are applied simultaneously from different directions. This type of force application represents more accurately the environment in an actual crash.

The Safety Board believes that there is sufficient data currently available to support the upgrading of the occupant crash protection standards in the regulations. Further, the substantial body of knowledge and practical experience in design, construction, testing, and use of crashworthy structures and cabin furnishings can be applied successfully to large transport aircraft, in many cases without substantial penalties in cost or weight and without major modifications to existing structures. The Safety Board also believes that the FAA should concentrate its research efforts on applying available technology to transport aircraft, and in newer areas, such as crashworthiness of composites, instead of continuously reevaluating past work that has been proven valid through actual use for at least 10 years, in both the aviation and automotive industries.

As a result of its special study, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish a separate single subpart in 14 CFR 25 which consolidates crashworthiness requirements for transport category aircraft pertaining to areas such as crash models, occupant protection requirements, emergency egress, retention of items of mass, and seat and seat restraint systems. (Class III, Priority Action) (A-81-139)

2/ Aircraft Crash Survival Design Guide, USARTL-TR-79-22, Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia, 1980.

3/ Desjardins, S. P., and D. H. Laananen, "Transport Category Aircraft Seat Strength Proposed Modification to FAR Part 25," TI-8017, Simula Inc., Tempe, AZ, 1980.

Revise the crashworthiness requirements as presently described under Emergency Landing Conditions, 14 CFR 25.561, to eliminate reference to the term "minor crash landing," and to include a descriptive crash model determined from FAA's Transport Aircraft Crashworthiness Program. (Class III, Priority Action) (A-81-140)

Establish and specify in the appropriate subpart of 14 CFR 25, interim standards for the design of seat and restraint systems and cabin furnishings to withstand the multiaxis acceleration levels such as those described by Simula Inc. in its Paper TI-8017. (Class II, Priority Action) (A-81-141)

Establish and specify in the appropriate subpart of 14 CFR 25 and in the related Technical Standard Orders, interim standards for static and dynamic testing of seat/restraint systems, including consideration of warpage or buckling of the attaching structure, and multiaxis dynamic pulses such as those described by Simula Inc. in its Paper TI-8017 and in the Aircraft Crash Survival Design Guide. (Class II, Priority Action) (A-81-142)

Establish an internal procedure which will ensure the periodic review of state-of-the-art crashworthiness design and testing technology and will reflect the improved technology through upgraded standards. (Class II, Priority Action) (A-81-143)

KING, Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, and McADAMS, Member, did not participate.

*for*   
By: James B. King  
Chairman



US Department  
of Transportation  
  
Federal Aviation  
Administration

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

January 20, 1982

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-145 through A-81-147 issued by the Board on October 14, 1981. These recommendations resulted from the Board's special investigation of the air traffic control (ATC) system of the United States. The Board's "Special Investigation Report — Air Traffic Control System" (NTSB-SIR-91-7) was adopted on December 8, 1981.

A-81-145. Establish and implement a program to detect the onset of, and to alleviate, controller fatigue and stress.

FAA Comment. The NTSB found little if any evidence of controller fatigue or stress during its investigation. It attributes this lack of fatigue and stress to the current attitude of controllers, which is manifested by very high morale and a dedication to the rebuilding of the ATC system. The NTSB presumes that the current high morale and concomitant lack of fatigue and stress cannot be expected to continue.

We agree with the observation that attitude is a significant factor in mitigating fatigue and stress. This observation is consistent with the findings of a 5-year study of controllers conducted by Boston University. The report of that study, prepared by Dr. Robert Rose, clearly indicated that workload and the work itself were not the sources of health change effects or perceived stress. Rather, it was the context or environment within which the work was performed that was the major source of perceived stress. The clear inference from the report is that the adversary relationships that existed between management and the controllers' union created an atmosphere conducive to the development of perceived stress. Thus, it is not surprising that the NTSB report found that: "For most of the current work force, the atmosphere is now perceived as pleasant and they do not mind working harder in terms of workload or hours. Most working controllers indicated that they believe they can do what is necessary until the system is restored to normal."

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Although it would appear that the major sources of stress which existed prior to the strike have now vanished, the Federal Aviation Administration (FAA) has taken a number of actions to minimize other environmental factors which may relate to fatigue and stress. Those actions have included:

- Reduction in number of total flights handled by the system.
- Centralized flow control to reduce airborne delays to keep demand within system capacity.
- Continue reduction of scheduled work hours from an initial high of 50+ hours per week during the first few days following the strike to a maximum of 45 hours per week at the present time. We are committed to returning to a 40-hour workweek as soon as possible.
- Actively evaluate/monitor programs wherein air traffic evaluation specialists regularly visit field facilities to review air traffic operations and controller performance, with emphasis placed on reviewing workload/environmental conditions relative to controller fatigue and stress.
- Through regular telephonic communication between headquarters, regions, and field facilities, stress the importance of supervisors being alert to the symptoms of fatigue and stress and to take action wherever required.

These actions are expected to reduce the possibility of development of fatigue and stress and should be viewed as effective preventive measures.

For the longer term, actions have been taken to accelerate training and staffing to increase the work force. The FAA has also initiated a review to consider the need for, and method of, conducting a monitoring system which would serve to identify controllers who might be suffering from fatigue or stress. When this review is completed, a recommendation will be made as to whether a monitoring system should be implemented and the specific action that should be taken, if a monitoring program is established. In the meantime, the actions taken by the FAA will be continued.

A-81-146. In addition to recent efforts to reduce scheduled IFR traffic now operating under national flow controls, implement additional controls both at the national facility levels which will reduce controller and facility workloads by limiting nonscheduled IFR operations and air traffic control and discretionary services being provided to VFR operations.

FAA Comment. The Air Traffic Service has implemented two major programs and has one ready to implement to control the majority of traffic within the National Airspace System (NAS). The Air Traffic Interim Operations Plan limits air carrier/commuter operations at the 22 major traffic hubs during peak hours. This limitation reduces overall air carrier operations by approximately 20-23 percent nationwide and effectively balances workload during peak hours.

The General Aviation Reservation (GAR) program limits general aviation and, on demand, air taxi operations for a 14-hour period each day throughout the NAS. GAR quotas have stabilized traffic and balanced the workload. GAR was implemented on October 19, 1981, and analysis shows that gross distortions are being removed from the system. Throughout the NAS, general aviation and air taxi operations combined accounted for 38 percent of total en route operations in fiscal year 1980, while air carriers accounted for 45 percent and military for 17 percent. The general aviation/air taxi category reached 43 percent of total operations prior to GAR. In the October 27 - November 2, 1981, period under GAR, the same category has been reduced to 39 percent with air carriers at 44 percent and military at 17 percent. (See enclosure which shows a geographical breakdown of combined general aviation/air taxi activity).

Most delays since the August 3, 1981, strike have been ground-imposed delays rather than airborne delays and this can be attributed to effective flow management programs administered by the Air Traffic Control Command Center. These programs not only conserve aviation fuel, but also reduce peak traffic workload. In addition, we are currently developing customized flow scenarios to reduce traffic at impacted en route facilities/sectors which will match the traffic to the personnel through effective, timely rerouting of traffic.

We are developing an Expanded Tower En Route Control (ETEC) program which is designed to relieve the workload on critically staffed facilities by redistributing traffic to other facilities with better resources. The ETEC program has removed traffic from low altitude sectors of critically staffed Air Route Traffic Control Centers and placed it under control of better staffed terminal facilities. This expansion of terminal control has been accomplished by increasing the vertical and geographic limits of some approach control areas.

Maximum effort will be made to expand existing routes and develop new routes to create as broad a network as possible. The routes will be designed to serve metropolitan areas, not just major airports.

The ETEC program is intended primarily for nonjet aircraft. There will be no attempt to change flight profiles to take jet aircraft out of the high altitude structure to include them in the ETEC program.

Other services, such as VFR practice instrument approaches, continue to be handled on a workload-permitting basis in light of higher priority duties. Facility managers and supervisors are acutely aware of the dangers involved in overextending efforts to provide services. In some cases, facility managers have coordinated with local users to encourage the scheduling of training missions during nonpeak periods.

A-81-147. Require that, at any time a first-line supervisor is to work a control position in addition to performing supervisory duties, a procedure is in place at the facility through which qualified personnel are immediately available for assistance or coordination.

FAA Comment. Though this recommendation is ideologically sound, it is not entirely practical in all situations. Our supervisors normally arrange for either another supervisor or qualified controller to be available as needed and assume their responsibilities when they are working an operational position or otherwise not available to assist. There are occasions when, due to staffing limitations or unexpected situations such as an accident or sudden illness, it is not possible for a supervisor to have the luxury of an extra person to be temporarily available. Though circumstances as described in the recommendation do occur, they are an exception rather than the rule. Even under these rare circumstances, supervisors, working a position, are still in charge of their operational area and do not abdicate their supervisory responsibilities. In the final analysis, we cannot agree with this recommendation since there is no possible means to require available assistance for coordination in every situation 100 percent of the time.

Sincerely,



J. Lynn Helms  
Administrator

Enclosure

Percent of Total Operations by En Route Center  
for Air Taxi and General Aviation Combined

	<u>Pre-GAR High</u>	<u>Post-GAR 10/27-11/2</u>	<u>FY-80 Norm</u>	
NAS	43	39	38	
	30	21	19	Albuquerque
	44	40	39	Atlanta
	50	44	42	Boston
	53	49	50	Chicago
	54	48	48	Cleveland
	35	30	27	Denver
	52	39	38	Fort Worth
	52	40	41	Houston
	56	49	50	Indianapolis
	38	35	31	Jacksonville
	38	30	31	Los Angeles
	52	46	42	Kansas City
	53	43	42	Memphis
	34	34	31	Miami
	47	40	39	Minneapolis
	41	38	38	New York
	41	37	39	Oakland
	34	29	31	Salt Lake City
	53	50	53	Seattle
	42	44	35	Washington

NAS	<u>A/C</u>	<u>AT &amp; GA</u>	<u>Mil.</u>
FY 80	45	38	17
10/27-11/2	44	39	17

Prior to implementation of GAR, delays of 30 minutes or more were averaging 778 per day. The average for the first two weeks since the GAR implementation has been reduced to 464 per day.

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: October 14, 1981

-----  
Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-145 through -147

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On August 18, 1981, the National Transportation Safety Board began a special investigation of the air traffic control (ATC) system of the United States. A major issue in our investigation is the Federal Aviation Administration's (FAA) program to monitor the emergence of fatigue and stress in individual controllers which may result from the extended work hours and the heavier workloads encountered by controllers since the onset of the Professional Air Traffic Controllers Organization (PATCO) strike of August 3, 1981.

The Safety Board's review of ATC surveillance reports submitted by FAA General Aviation and Flight Standards District Office inspectors to FAA management indicated that there currently is no evidence that fatigue and stress problems have emerged among the controllers. However, these reports indicate that some controllers are apprehensive that the extended work hours and heavier workloads will produce fatigue and stress in the future. During the ongoing Safety Board survey of more than 41 air traffic facilities, investigators have interviewed nearly 200 of the controllers and supervisors now operating the system. Most of these individuals have stated that fatigue and stress have not emerged as significant problems. These controllers have also stated that the general spirit of user cooperation, teamwork, and a sense of job accomplishment has produced an emotional uplift which has offset the effects of extended work hours. However, there was a pervasive feeling on their part that the uplift is likely to be short-term and that fatigue and stress might affect their performance in the future. Many of the controllers stated that the extended work week had disrupted their personal lives.

The Safety Board is concerned that the long-term effects of the current work schedules will lead to fatigue and stress which may eventually degrade controller efficiency and aviation safety. Based on our investigators discussions with the Federal Air Surgeon and management officials of FAA's Air Traffic Service, we have determined that no national or regional guidelines have been disseminated by the FAA to ATC facilities to assist first-line supervisors in detecting the emergence of fatigue and stress. To forestall any adverse effect on aviation safety the Safety Board believes that an appropriate fatigue/stress detection program should be initiated in each air traffic facility. In order for such a program to be effective, all ATC supervisory personnel should be instructed to recognize the early warning signs of fatigue and stress. We believe that a program to this end should receive a high priority.

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The FAA's flow control procedures were instituted to insure a continual metering of traffic and, in turn, to preclude overloads of the ATC system. Flow control has generally served its purpose with respect to scheduled air carrier, air taxi, and most IFR operations, although recurrent traffic peaking problems continue to arise. Overall, our investigators' observations at many facilities, as well as interviews with controllers and a review of facility traffic counts, indicate that since the end of August controller workload has increased significantly. Currently the controller workloads appear to be manageable, but they are approaching levels where individuals and facilities are reaching the saturation level. This traffic increase is not primarily the result of inadequate flow control procedures, but rather is attributable to a combination of increases in flow-controlled IFR traffic, increases in VFR transient traffic, and the provision of additional air traffic services to VFR flights. At the Denver Tower, by September 1 the daily traffic count had sometimes reached levels which were about 94 percent of prestrike levels, although the total number of working controllers was 60 percent of prestrike levels. Atlanta ARTCC handled about 93 percent of prestrike operations during August, 1981, with about 55 percent of the previous controller workforce. Additionally, high traffic counts were noted at other facilities despite the reduced controller staff levels. Moreover, some general aviation pilots apparently have circumvented the ATC system traffic restrictions by using the special air taxi suffix "TN" in their flight plans. Illustrative of the problem is an FAA report that in August the Minneapolis Air Traffic Control Center (ARTCC) had 5,300 air taxi operations, while in July there had been only 4,400 air taxi operations.

The Safety Board realizes that it is possible to handle a large number of aircraft if the flights are spread over a period of time. However, our investigators observed that many controllers were increasing their workloads by volunteering additional services or by accepting VFR transient aircraft at high density airports. Although a helpful attitude on the part of individual controllers results in more services to more pilots, there is evidence that individual controllers may fail to understand the effects of the additional workload on controllers in adjoining sectors or on the facility and national flow control procedures. As a result, the good intentions of the controller workforce may tend to reduce the effectiveness and safety of the flow control concept and to overtax the current ATC system. Of course this additional workload may have both short- and long-range effects on controller fatigue and stress.

The Safety Board is aware that the FAA is maintaining close surveillance of its flow control procedures. The recently announced FAA program will reduce scheduled commercial operations, from 83 percent of scheduled operations to 78 percent, and the General Aviation Reservation Program will limit the overall increases in total traffic count. These programs will enable the ATC system to manage flow-controlled air traffic without saturating individual controllers or facilities, while providing a margin to accommodate unforecast traffic peaks. However, our investigation suggests that localized VFR traffic and nonscheduled IFR operations have led to increases in controller workload which have not received comparable attention. As a result, we believe that the current program to reduce flow-controlled traffic should also include controls of VFR and nonscheduled IFR traffic at various facilities. Finally, future programmed increases in the total volume of air traffic operations must more closely consider controller workforce capabilities.

A second major issue in our special investigation was the nature of the ongoing supervision of controllers. Specific supervisory procedures are outlined in individual facility orders. The FAA Facility Operation and Administration Manual underscores the importance of providing supervision at the first-line level, even when a supervisor may be performing controller duties. Our investigators observed several instances where during periods of heavy traffic workload first-line supervisors were assigned duties in

a sector or an operating position in addition to supervisory duties. The Safety Board recognizes the reasons for this practice and believes it is acceptable under certain traffic conditions. However, it can reduce the effectiveness of first-line supervision during heavy workload conditions unless appropriate procedures exist to provide assistance to the supervisor/controller. Such a situation arose during the investigation when our investigators observed a first-line supervisor who was also working a control position which had a heavy traffic load. The supervisor was unable to perform supervisory duties, and there was no other person in the area to provide assistance or backup supervision. When the traffic load forced the supervisor/controller to request controller assistance at his position, 4 minutes elapsed before another controller was able to assist him. Procedures for having first-line supervision immediately available for assistance and coordination are critical to the air traffic system, and must be a part of each facility's planning.

Accordingly, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish and implement a program to detect the onset of, and to alleviate, controller fatigue and stress. (Class II, Priority Action) (A-81-145)

In addition to recent efforts to reduce scheduled IFR traffic now operating under national flow controls, implement additional controls both at the national and facility levels which will reduce controller and facility workloads by limiting nonscheduled IFR operations and air traffic control and discretionary services being provided to VFR operations. (Class I, Urgent Action) (A-81-146)

Require that, at any time that a first-line supervisor is to work a control position in addition to performing supervisory duties, a procedure is in place at the facility through which qualified personnel are immediately available for assistance or coordination. (Class II, Priority Action) (A-81-147)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: James B. King  
Chairman



US Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave S W  
Washington, D C 20591

January 12, 1982

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-148 and A-81-149 issued by the Board on October 23, 1981. These recommendations resulted from the Board's investigation of the crash of a Beechcraft Model E 90, N2181L, into Lake Michigan. The aircraft wreckage was located on December 10, 1980, about 1 mile west of Grand Beach, Michigan, pumping station.

A-81-148. Request that all General Aviation District Office Maintenance Inspectors review the procedures of repair stations under their jurisdiction to ensure that aircraft records are thoroughly reviewed and that the proper inspections are performed under the provisions of 14 CFR 91.217.

FAA Comment. The thrust of the NTSB's recommendation suggests that a maintenance entity is responsible for the entire aircraft following any maintenance directed by the owner. This represents direct opposition to the existing regulatory philosophy and specific requirements. The present regulations clearly state that the owner is entirely responsible for obtaining the proper inspection and for repairing defects between inspections.

Your discussion states that the aircraft was being maintained under a progressive type inspection. However, the recommendation is related to inspection performed under the provisions of 14 CFR 91.217. Section 91.217(c)(4) requires an owner or operator to identify a person responsible for scheduling the inspection selected under §91.217(b). Regardless of the inspection program being used (i.e., Progressive or 14 CFR 91.217), it is the responsibility of the person indicated in those programs to assure the proper inspection is scheduled at the proper time. This does not relieve the owner or operator of his responsibility to comply with §91.165 and the repairing of defects.

The discovery of the noise under the pilot's seat was not a portion of the requested inspection. However, the repair station did act prudently and responsibly in advising the owner of the discrepancy. Thus the responsibility was clearly placed upon the owner/operator to have the defect repaired. In this case the pilot was at fault for deferring the control noise item. As you point out in the recommendation, "Our investigation indicates that the improperly serviced pivot bolt appears to have been an isolated occurrence." We also conclude that this is an isolated case and that the corrective action recommended by the NTSB would not be cost effective nor would it enhance safety.

A-81-149. Require the Great Lakes region to conduct a thorough inspection of and a review of the procedures and practices of the involved repair station.

FAA Comment. The Great Lakes Region reviewed the procedures and actions of the repair station involved and found them to be fully adequate and in compliance with the Federal Aviation Regulations.

The pilot of the aircraft was the Director of Operations and was the person assigned the responsibility by the operator for scheduling the proper inspection. In that the pilot is deceased, no actions could be taken against him. Enforcement action was, however, taken against the Air Carrier Operating Certificate holder for the operation of an unairworthy aircraft.

We consider action on Safety Recommendations A-81-148 and A-81-149 completed.

Sincerely,

  
J. Lynn Helms  
Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: October 23, 1981

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-81-148 and -149

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On December 7, 1980, a Beechcraft Model E 90, N2181L, departed O'Hare International Airport, Chicago, Illinois, on an instrument flight rules flight plan to Michigan City Airport, Michigan City, Indiana. The flight was conducted under the provisions of 14 CFR 135, and there were three passengers and a pilot on board.

After departing O'Hare, control of the aircraft was transferred to Chicago Air Route Traffic Control Center (ARTCC) and then to South Bend Approach Control. When South Bend Approach Control established radar contact with the flight, both radar vectors and the current South Bend altimeter setting were given to the pilot for a nondirectional beacon (NDB) approach to the Michigan City airport. South Bend Approach Control made several transmissions to the flight which were acknowledged by the pilot. About 6 miles north of the airport, radar contact with the aircraft was lost; several additional transmissions were made to the flight but they were not acknowledged.

The aircraft wreckage was located on December 10, 1980, in Lake Michigan about 1 mile west of the Grand Beach, Michigan, pumping station. The bodies of two passengers have been recovered, but the pilot and one passenger remain missing and are presumed dead.

The maintenance records and aircraft logbooks indicated that the aircraft had accumulated about 2,913 hours and was being maintained under a progressive-type inspection program. The records also indicated that the aircraft had received a 100-hour inspection at KAL-AERO, Inc., an approved repair station on November 17, 1980. This inspection system consisted of alternate 100- and 200-hour inspections. The system was set up in such a way as to insure that all the critical elements of the aircraft were inspected within the 200-hour cycle. During a 100-hour inspection, the fuel system, oil system, air conditioning system, electrical system, landing gear, and the elevator and rudder trim systems are checked. During a 200-hour inspection, items inspected include the nose gear steering, flight control bellcranks and pulleys, aileron, rudder, and elevator cables.

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A review of the aircraft logbooks indicated that the aircraft should have been given a 200-hour inspection on November 17, 1980, rather than the 100-hour inspection that was performed. Upon review of the discrepancies discovered during the 100-hour inspection, the Safety Board found that several items had been deferred on instructions of the pilot. Included among the deferred items was "elevator push pull rod at bellcrank under pilot's chair noisy."

During the examination of the wreckage, the pivot bolt for the elevator forward bellcrank was found to be missing and the bellcrank had moved forward in its attachment bracket. The elevator forward bellcrank is mounted under the cockpit floorboards. The pivot bolt was later located in the area of the bellcrank, but the nut and washer were never found. Examination of the pivot bolt, bellcrank, and attachment bracket indicated that the bolt had not been in place for some time and that the attachment bracket had retained the bellcrank in a position relatively close to its normally assembled position. Examination of the threads on the pivot bolt indicated that the nut probably had never been installed. The Safety Board could not ascertain whether the pivot bolt and nut had been removed or replaced during previous aircraft maintenance.

A test was conducted using another aircraft in which the nut was removed from the pivot bolt of the elevator forward bellcrank and the controls operated without load. The test showed that the bolt would move up and out of the attachment bracket when the elevator control was operated. The test also demonstrated that when the bellcrank was retained near its normal assembled position, limited elevator control was possible; when the bellcrank moved forward in the attachment bracket, elevator control was lost.

The mechanic who made the entry in the logbook, verifying its airworthiness and releasing the aircraft for flight, stated that he did not verify that the 100-hour inspection was the correct inspection to be performed. Had the mechanic reviewed the maintenance logbook, he would have known that the aircraft was due a 200-hour inspection. Had the 200-hour inspection been accomplished, the problem with the elevator pivot bolt might have been identified and corrected.

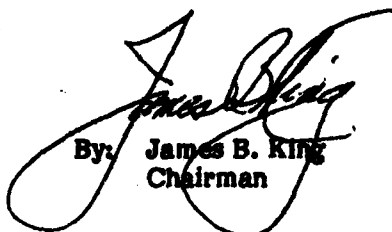
Our investigation indicates that the improperly secured elevator pivot bolt appears to have been an isolated occurrence. We have been advised that a General Aviation Airworthiness Alert concerning the need for a thorough inspection of the forward elevator bellcrank pivot bolt assembly will be issued. However, the Safety Board is also concerned about the discrepancies found during this investigation regarding the operation of the repair station. The aircraft was returned to service with an uncorrected discrepancy in a primary flight control system, and the repair station personnel failed to accomplish the proper 200-hour inspection.

Therefore, the National Transportation Safety Board believes that corrective action is required and recommends that the Federal Aviation Administration:

Request that all General Aviation District Office Maintenance Inspectors review the procedures of repair stations under their jurisdiction to ensure that aircraft records are thoroughly reviewed and that the proper inspections are performed under the provisions of 14 CFR 91.217. (Class II, Priority Action) (A-81-148)

Require the Great Lakes region to conduct a thorough inspection of and a review of the procedures and practices of the involved repair station.  
(Class II, Priority Action) (A-81-149)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, Member, concurred in these recommendations. GOLDMAN, Member, disapproved and BURSLEY, Member, did not participate.

  
By: James B. King  
Chairman



US Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

February 23, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-154 through A-81-156 issued by the Board on December 10, 1981. These recommendations resulted from the Board's special investigation of the air traffic control (ATC) system of the United States. The Board's "Special Investigation Report—Air Traffic Control System" (NTSB-SIR-81-7) was adopted on December 8, 1981.

A-81-154. Establish a program to periodically reemphasize use of the National Aeronautics and Space Administration's Aviation Safety Reporting System (ASRS) by controllers to report hazardous conditions.

FAA Comment. We will periodically reemphasize to controllers the availability of NASA's Aviation Safety Reporting System (ASRS) to report hazardous conditions. We have also instituted a procedure whereby the ASRS monthly newsletter is being mailed to all air traffic control facilities, in addition to the ASRS quarterly reports. The Airman's Information Manual, Basic Flight Information and ATC Procedures, Section 6, Safety, Accident and Hazard Reports, is being updated to reflect the latest status of the program and the availability of reporting forms. We consider action completed on Safety Recommendation A-81-154.

A-81-155. Adopt procedures and directives to use the student evaluations prepared by academic personnel at the FAA controller training center as a placement tool for new controllers.

FAA Comment. Implementation of this recommendation is not feasible during our rebuilding effort. Personnel assignments must continue to be based on the needs of the system and each facility's training capacity. Consistently, where feasible, regional offices are using student evaluations as a placement tool for newly hired potential controllers. Additionally, Radar Training

Facility (RTF) scores will be utilized as a part of the competitive process when selecting controllers for radar positions. The FAA plans no further action on Recommendation A-81-155 at this time.

A-81-156. Establish a periodic formal evaluation process to monitor the standardization of ATC practices and proficiency of controllers utilizing a facility's staff specialists as well as first-line supervisors.

FAA Comment. We presently have an established Technical Appraisal Program (TAP) Over-the-Shoulder Evaluations (copy enclosed). This program is to be utilized by both first-line supervisors and facility staff specialists at least two times a year. Accordingly, the FAA intends to take no further action on Safety Recommendation A-81-156.

Sincerely,



J. Lynn Helms  
Administrator

Enclosure

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: December 10, 1981

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-154 through -156

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On August 18, 1981, the National Transportation Safety Board began a special investigation of the air traffic control (ATC) system of the United States. The Safety Board conducted in-depth studies of 45 ATC facilities to observe the operation of the ATC system under the reduced controller workforce levels. About 220 controllers and supervisors were interviewed in the ATC facilities. Additionally, the Safety Board analyzed the Federal Aviation Administration (FAA) program for the training of replacement controllers, for the management of the current controller workforce, and for programs to detect and control stress and fatigue in the controller population. <sup>1/</sup>

The interviews with controllers and supervisors and a review of National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) data indicated that some working controllers were either unaware of the ASRS system or did not appreciate the system's potential to identify safety deficiencies. This was reflected in the comments of the controllers and the review of the data. The Safety Board believes that the ASRS program is an important means to identify safety deficiencies in the National Airspace System. The ASRS program should be a safety tool at each ATC facility, and new controllers coming into the FAA should have a full understanding and appreciation of the ASRS program.

The investigation of the FAA's program to train replacements for the controller workforce indicated that the training potential of the Mike Monroney Aeronautical Center is not being used properly with respect to the assignment of new controllers. The center has the ability to identify trainees who have the potential to work at high-density ATC facilities. This determination, which is based on academic evaluations and the performance of the trainee in the radar training facility, can reduce failure rates by insuring that trainees are assigned to the facilities where they are most likely to succeed. However, the current practice is to assign a student to a facility before the person is evaluated at the training center. As a result, the center's potential to provide accurate trainee evaluation and have an influence on initial assignments is not used. Training personnel at the center cited examples of

<sup>1/</sup> For more detailed information, read Special Investigation Report—"Air Traffic Control System" (NTSB-SIR-81-7).

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developmental controllers who have shown potential for radar control duty in Terminal Radar Approach Control facilities with high-density traffic being assigned to VFR (visual flight rules) towers. When the subject was discussed with training center personnel, they stated that it was an administrative procedure beyond their control. They stated that a student's grade and instructor evaluations are forwarded to the region for its use. In fact, they stated that one region requested that this practice be discontinued. The Safety Board believes that more emphasis should be placed on the capability of the center to evaluate and recommend placement of trainees. An assignment procedure based on center evaluations should reduce the facility failure rate and make controllers operational in a short time.

The investigation indicated that the over-the-shoulder training evaluation which the FAA uses to monitor the proficiency and training needs of controllers is ineffective. The Safety Board agrees that a formal controller evaluation process is necessary. However, the program must be effective and must provide a means to measure the proficiency and standardization of the controller workforce. Since most controllers and supervisors agreed that the current over-the-shoulder evaluation was not effective, the FAA should develop a new, standardized program which would measure the proficiency and standardization of both the controllers and the supervisors and staff who maintain certification on sectors and operating positions.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish a program to periodically reemphasize use of the National Aeronautics and Space Administration's Aviation Safety Reporting System (ASRS) by controllers to report hazardous conditions. (Class III, Longer-Term Action) (A-81-154)

Adopt procedures and directives to use the student evaluations prepared by academic personnel at the FAA controller training center as a placement tool for new controllers. (Class III, Longer-Term Action) (A-81-155)

Establish a periodic formal evaluation process to monitor the standardization of ATC practices and proficiency of controllers utilizing a facility's staff specialists as well as first-line supervisors. (Class II, Priority Action) (A-81-156)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, AND BURSLEY, Members, concurred in these recommendations.



James B. King  
Chairman



US Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. SW  
Washington, D.C. 20591

February 23, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-161 issued by the Board on January 5, 1982. This recommendation resulted from the Board's investigation of the crash of a Beech aircraft model 65-A80-8800, N100UV, on July 2, 1981, 7 miles east-southeast of Madisonville, Texas.

A-81-161. Issue a General Aviation Airworthiness Alert (Advisory Circular 43-16) to emphasize the importance of following the established procedures published in the manufacturer's engine overhaul manual with regard to masking machined bosses when crankcase areas are painted.

FAA Comment. We concur with the NTSB recommendation. The following item will be placed in the next available issue of the General Aviation Airworthiness Alerts (AC 43-16): "Recent disassembly of an engine revealed a majority of cylinder base nuts were under-torqued, probably the result of paint on the machined bosses under the hold down nuts. Maintenance personnel should meticulously follow manufacturer's instructions regarding any finish applied to any machined boss to preclude over-torqued or under-torqued fasteners." The Federal Aviation Administration will advise the Board upon issuance of this item in AC 43-16. We plan no further action on this recommendation and consider it completed.

Sincerely,

J. Lynn Helms  
Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: January 5, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591  
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SAFETY RECOMMENDATION(S)

A-81-161

On July 2, 1981, a Beech aircraft model 65-A80-8800, N100UV, was involved in a fatal accident about 7 miles east-southeast of Madisonville, Texas. The National Transportation Safety Board's investigation has revealed a maintenance problem which we believe warrants attention.

The aircraft was equipped with two Avco Lycoming direct drive engines, Model IO 720-A1B. Disassembly and examination of these engines revealed that a majority of the cylinder base nuts on the right engine, S/N 2-949-54A, were under-torqued. Further examination disclosed that the cylinder boss area under the nuts had been painted. The overhaul manual, section 3, paragraph 3-28, for these engines specifies that "all machined bosses should be masked before painting. Do not paint areas under hold down nuts where torque is required."

Although the under-torqued condition of the engine cylinder base nuts was not considered a factor in this accident, the loss of a cylinder because of this condition could result in a potentially hazardous situation.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue a General Aviation Airworthiness Alert (Advisory Circular 43-16) to emphasize the importance of following the established procedures published in the manufacturer's engine overhaul manual with regard to masking machined bosses when crankcase areas are painted. (Class II, Priority Action) (A-81-161)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS and BURSLEY, Members, concurred in this recommendation. GOLDMAN, Member, did not participate.

By:  James B. King  
Chairman

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U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

March 11, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-162 issued by the Board on January 5, 1982. This recommendation resulted from the Board's investigation of the crash of a Beech aircraft model 65-A80-8800, N100UV on July 2, 1981, 7 miles east-southeast of Madisonville, Texas.


A-81-162. Require all holders of an instrument rating and a multiengine rating to demonstrate their ability to operate a multiengine aircraft under normal and emergency conditions by reference to flight instruments only as a prerequisite to exercising the privileges of an instrument rating in multiengine aircraft.

FAA Comment. The Federal Aviation Administration (FAA) concurs in principle with Safety Board Recommendation A-81-162. We are presently conducting a regulatory review of 14 CFR Parts 61 and 141 to identify areas of potential revision. The FAA is considering requiring multiengine pilots, both instrument rated and noninstrument rated, to demonstrate appropriate degrees of instrument proficiency.

We have included Recommendation A-81-162 in the agenda for consideration during the review and update of 14 CFR Parts 61 and 141. It is anticipated that a Notice of Proposed Rulemaking will be issued in early 1983.

We will keep the Board informed of the progress as our review program continues.

Sincerely,

  
J. Lynn Helms  
Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: January 5, 1982

Forwarded to:  
Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-162

About 1230 e.d.t. on July 2, 1981, a Beech aircraft model 65-A80-8800, N100UV, operated by Universal Airways, Inc., under 14 CFR 91, crashed about 7 miles east-southeast of Madisonville, Texas. Witnesses heard a small explosion and saw the aircraft descend from a dark cloud; the wings and the empennage were not attached during the observed portion of the aircraft's descent. The pilot and both passengers were killed. The aircraft was destroyed. 1/

The investigation indicates that the in-flight breakup was probably caused by excessive airloads generated by a nose up control input by the pilot at high speed. Based on weather observations made by the National Weather Service, reports from pilots in the Madisonville area, and observations of witnesses to the accident, the in-flight breakup may have occurred in light-to-moderate turbulence in instrument meteorological conditions.

A review of the pilot's records indicated that he had limited experience in the operation of multiengine aircraft in instrument meteorological conditions and had not received instrument training in a multiengine aircraft. Because the pilot had acquired an instrument rating in a single-engine aircraft, he had not been required to demonstrate to a flight instructor or flight examiner his ability to satisfactorily cope with in-flight emergencies, such as unusual attitudes, gyro instrument failure, or engine failure, in a multiengine aircraft under simulated or actual instrument meteorological conditions.

1/ For more detailed information, read Aircraft Accident Report - "Universal Airways, Inc., 65-A80/Excalibur Conversion, N100UV, Near Madisonville, Texas, July 2, 1981" (NTSB-AAR-81-17).

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While there is a commonality between single-engine and multiengine instrument flying techniques and procedures, multiengine aircraft require a greater degree of piloting skill because of the additional powerplants, more complex systems, and larger sizes and weights. The Safety Board believes that the differences in the flight characteristics and emergency procedures between single-engine and multiengine rating aircraft are such that flight instructors/examiners should require multiengine applicants who received their instrument rating in a single-engine aircraft to satisfactorily demonstrate their ability to handle abnormal in-flight situations in a multiengine aircraft under actual or simulated instrument meteorological conditions.

Accordingly, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require all holders of an instrument rating and a multiengine rating to demonstrate their ability to operate a multiengine aircraft under normal and emergency conditions by reference to flight instruments only as a prerequisite to exercising the privileges of an instrument rating in multiengine aircraft. (Class II, Priority Action) (A-81-162)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS and BURSLEY, Members, concurred in this recommendation. GOLDMAN, Member, did not participate.



By: James B. King  
Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

February 22, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This will acknowledge receipt of NTSB Safety Recommendations A-82-6 through A-82-15 issued by the Board on January 28, 1982. These recommendations resulted from the Board's investigation of Air Florida Flight 90, a Boeing 737-222 (N62AF). The aircraft failed to achieve a sufficient rate of climb, struck the 14th Street Bridge about 4,500 feet from the departure end of runway 36 at Washington National Airport, and crashed into the Potomac River.

FAA General Remarks. The Federal Aviation Administration (FAA) will also take this opportunity to advise the Board of the various programs, plans, actions, and implementation strategies that we have underway or planned relative to the subject recommendations.

A-82-6. Immediately notify all air carrier operators of the potential hazard associated with engine inlet pressure probe icing, and require that they provide flightcrews with information on how to recognize this hazard and requiring that flightcrews cross-check all engine instruments during the application of takeoff power.

A-82-7. Immediately review the predeparture deicing procedures used by all air carrier operators engaged in cold weather operations and the information provided to flightcrews to emphasize the inability of deicing fluid to protect against reicing resulting from precipitation following deicing.

A-82-8. Immediately review the information provided by air carrier operators to flightcrews engaged in cold weather operations to ensure comprehensive coverage of all aspects of such operations, including the effects of a runway contaminated by snow or slush on takeoff, and methods to be used to obtain maximum effectiveness of engine anti-ice during ground operations and takeoffs.

A-82-15. Immediately disseminate the contents of this safety recommendation letter to foreign operators involved in cold weather operations.

FAA Comment A telegraphic message was transmitted on January 28 to all FAA facilities; U.S. air carriers; U.S. owners, operators, aircraft and engine manufacturers foreign authorities of known airplane registration; and other interested groups. This notice contains the verbatim contents of the Board's safety recommendation letter issued and transmitted to the FAA on January 28. The purpose of the transmittal to all air carrier operators and manufacturers was to ensure their awareness of the preliminary findings and recommendations as requested by the Board.

A telephone conference (telecon) was conducted on January 29 involving FAA headquarters and all FAA regional flight standards division personnel. The telecon was initiated to advise regional flight standards personnel to contact all air carriers, with the emphasis on operators of turbine-powered aircraft, to review the Board's safety recommendations and each operators' respective cold weather operational procedures, training programs, and contents of their operations manuals, as requested by the Board.

A survey report has been provided by each FAA region. This report indicates that all air carriers have been contacted and made aware of the safety recommendations and hazards associated with icing. The results of this survey indicate that there is a positive attitude on the part of industry concerning these safety recommendations.

In addition, an Air Carrier Operations Bulletin (ACOB) that emphasizes the appropriate use of engine anti-ice will be issued to the aircrews in the near future. A copy of this ACOB will be forwarded to the Board.

The FAA considers action completed on NTSB Safety Recommendations A-82-6, -7, -8, and -15.

A-82-9. Immediately require flightcrews to visually inspect wing surfaces before takeoff if snow or freezing precipitation is in progress and the time elapsed since either deicing or the last confirmation that surfaces were clear exceeds 20 minutes to ensure compliance with 14 CFR 121.629(b) which prohibits takeoff if frost, snow or ice is adhering to the wings or control surfaces.

FAA Comment. Reference to a time such as 20 minutes since deicing or the last confirmation that the aircraft surfaces were clear is not considered in the best interest of flight safety. Under some atmospheric conditions ice may form in a much shorter period whether ground deicing has been performed or not. Flightcrews must use the "clear aircraft" concept specified by current rules without regard to specific time intervals. Our rationale for this position is as follows:

1. Operators use various deicing fluids and strengths and use various application procedures resulting in differing characteristics.
2. Deicing fluid life is dependent upon many variables such as:
  - a. The type of fluid used.
  - b. Fluid strength. (Aqueous solutions of glycol can actually have lower freezing points than pure glycol.)
  - c. Residual moisture on the surface being treated.
  - d. Precipitation rate and type.
  - e. Ambient temperature and dew point.
  - f. Surface temperature as influenced by many factors (e.g., fuel temperature, insolation, wind chill, engine and/or APU operation, other systems operation, etc).
  - g. Recirculation effects, such as that possible by use of reverse thrust or that arising from taxi with a tailwind.
  - h. Fluid application procedures.
3. Under some atmospheric conditions "dry" snow may become wet snow, melt and refreeze on warm surfaces such as fuel tank areas, engine nacelles and areas heated by anti-icing systems, even if the aircraft was not deiced. Further, glycol deiced surfaces can turn "dry" snow into "wet" snow. Emphasis should be placed on visual inspection regardless of whether or not deicing has occurred, or when it has occurred.
4. Under some atmospheric conditions, ice or interfacial slush can form on one side of the aircraft while the other side is being sprayed.
5. Stating a specific time interval and mislead the flightcrew into not performing a needed pretakeoff inspection.

In our letter of February 11, 1981, in response to NTSB Safety Recommendation A-80-114, we emphasized the validity of the clean aircraft concept and indicated that a study of ethylene glycol mixtures as anti-icing agents would be undertaken by our R&D organization. The R&D study has been initiated and the initial steps include:

1. Review of current ground deicing and inspection procedures and current guidelines.
2. Review of recent studies on the effects of frost formations on aircraft performance.

### 3. Development of additional advisory information as necessary.

We believe these initial steps are necessary to form a sound basis for proper guidance or any changes or guidance material to current regulations. We also believe that these initial efforts are essential to identify specific additional R&D needs.

As a result of the Air Florida, Flight 90, B-737 accident and the subject recommendation, the R&D effort has been accelerated. We do not anticipate that changes will be made to the existing clean aircraft concept. However, information resulting from R&D efforts is expected to emphasize improved procedures to assure that hazardous ice formation does not exist prior to takeoff.

A-82-10. Immediately issue a General Notice (GENOT) to all FAA tower and air carrier ground control personnel alerting them to the increased potential for aircraft icing during long delays before takeoff and when aircraft operate in proximity to each other during ground operations in inclement weather, and encouraging procedural changes where possible so that the controllers implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, paragraph 1232.

FAA Comment. A copy of NTSB Recommendations A-82-6 through -15 was sent in its entirety to all air traffic facilities in GENOT form on January 28, as mentioned above. We believe the provisions of FAA Facilities Operations and Administration Manual 7210.3F, paragraph 1232, gate-hold procedures, adequately cover the handling of departure procedure delays. The GENOT of January 28 acts to remind facilities to review their application of these procedures.

A-82-13. Revise the air traffic control procedures with respect to aircraft taxiing for takeoff, holding in line for takeoff, and taking off to provide for increased ground separation between aircraft whenever freezing weather conditions and attendant aircraft icing problems exist.

FAA Comment. We do not agree that there is a need to revise air traffic control procedures as suggested in this recommendation. There are a large number of variables/unknowns associated with the problem of airframe and powerplant icing. We believe the pilot is the person best able to make decisions concerning aircraft operational requirements. Air traffic controllers will continue to provide service and special handling to aircraft as requested by the pilot.

A-82-14. Expand the training curricula for air traffic controllers and trainees to assure that instruction includes the hazards associated with structural and engine icing aircraft.

FAA Comment. In the meteorological portion of Phase II in the basic air traffic training program, indepth training is conducted to identify the forms of icing and its effects on aircraft performance.

Additionally, we will advise the present work force via the Air Traffic Service Bulletin of the hazard associated with structure and engine icing of aircraft.

The FAA considers action completed on NTSB Safety Recommendations A-82-10, -13, and -14.

A-82-11. Document the effect of engine inlet pressure probe blockage on engine instrument readings and require that such information be added to approved aircraft flight manuals.

A-82-12. Amend Advisory Circulars 91-13c, "Cold Weather Operation of Aircraft," and 91-51, "Airplane Deice and Anti-Ice Systems," to discuss in detail the effects and hazards associated with engine inlet pressure probe icing.

FAA Comment. A new advisory circular (AC) is being developed which will include a complete discussion of the hazards of engine inlet icing, pressure probe icing and blockage, and methods a flightcrew can use to recognize these conditions and properly use the engine anti-ice system. In addition, a detailed technical analysis is being undertaken in order to include specific engine instrument reading impacts, cross-check procedures, and performance degradation parameters in this AC. Initial information from this study is being immediately disseminated to the field in the ACOB described in our response to NTSB Safety Recommendation A-82-6. When completed, this AC will be forwarded to the Safety Board. Flight Manuals will be revised after the AC is completed, if such changes are deemed essential for flight safety.

In addition, the FAA will perform a detailed review of AC 91-13c and AC 91-51 in order to update them as required in areas other than that covered by the new AC on engine inlet icing.

Sincerely,



J. Lynn Helms  
Administrator

Enclosure

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**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: January 28, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
800 Independence Avenue, S.W.  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-82-6 through -15

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As a result of its continuing investigation of the crash of Air Florida Flight 90, a Boeing 737-222 (N62AF), about 1601 e.d.t. on January 13, 1982, the National Transportation Safety Board believes that immediate corrective action is needed in the area of cold-weather operations procedures. The aircraft had departed from runway 36 at Washington National Airport in moderate to heavy snowfall and low visibility. The aircraft failed to achieve a sufficient rate of climb, struck the 14th Street Bridge about 4,500 feet from the departure end of the runway, and crashed into the Potomac River. Seventy-four of the 79 persons aboard the aircraft were killed either on impact or by drowning, and 4 persons in automobiles on the bridge were killed when the vehicles were struck by the descending aircraft.

A weather observation taken within 15 minutes after the accident indicated that the visibility was 3/8 mile in snow, the temperature and dewpoint were both 24°, and the wind was from 020° at 13 knots. The evidence gathered to date shows that about 45 minutes had elapsed between the final deicing of the aircraft's aerodynamic surfaces with an ethylene glycol/water solution and the takeoff. During the 45-minute period, an additional 0.7 to 1.0 inch of snow had accumulated. Therefore, the Board's continuing investigation is focusing on, among other factors, those which could have affected the aircraft's takeoff and climb performance. These will include the effect of a runway contaminated by snow or slush on takeoff acceleration, the extent to which aerodynamic lift is degraded by contaminated airfoils, and the possible effects of engine nacelle and pressure probe icing.

In previous Safety Recommendations (A-80-112 through A-80-114), the Safety Board has expressed concern about the lack of knowledge of operators and flightcrews regarding the inability of deicing fluid to protect against icing from precipitation following deicing. We were pleased by the FAA's issuance of Air Carrier Operations Bulletin No. 7-81-1 and the proposed research and development study referenced in your February 11, 1981, letter to the Board. However, we now believe that more positive and immediate actions are needed to provide safe operations during the current winter months. Bulletin No. 7-81-1 advises principal inspectors to request operators to review their deicing and anti-icing procedures for

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adequacy. The Safety Board does not believe that this approach has obtained the needed results. Rather, the FAA must actually review prescribed procedures and those actually used by all air carrier maintenance and dispatch personnel, and flightcrews who routinely conduct cold weather operations to assure (1) that they are provided with sufficient and accurate information regarding proper deicing procedures and (2) that they are alerted to misconceptions regarding the anti-icing effectiveness of these procedures.

Additionally, the Safety Board's review of a number of air carrier operations manuals indicates that some do not contain information regarding the potential degradation in takeoff acceleration which can result from snow, slush, or water on the runway. More significantly, all operators of similar model aircraft apparently do not have standard, optimum procedures regarding the use of engine anti-ice during ground operation and takeoff. The preliminary investigation of the Air Florida accident indicates that the engine anti-ice system was OFF at the time of impact, and the Safety Board has not yet determined whether the engine anti-ice system had been used during the pre-takeoff ground operation.

Without regard to whether the ground operations had been conducted using engine anti-ice, the Safety Board is concerned that ice accumulation on the JT8D engine inlet pressure probe (PT2) could have affected the function of the engine pressure ratio (EPR) indicator to the extent that the crew was presented with a false indication of takeoff thrust when the engine reached some lower thrust level. Recent discussion with another air carrier has recently disclosed that an abnormal number of takeoffs have been rejected by pilots of B-737 and B-727 aircraft because of problems with EPR indications during the recent cold weather. In all of these instances, pilots stated that both ground operations and the attempted takeoff were conducted with engine anti-ice ON and operating and in all cases the takeoff was rejected because the EPR indication failed to reach takeoff values. Preliminary discussions between our engineering staff, a representative of the engine manufacturer, and air carrier engineering personnel indicate that, with a blocked PT2 probe, the EPR indicator will give an indication that thrust is higher than actual with engine anti-ice OFF and that is lower than actual with anti-ice ON. Any inaccurate indication of thrust level presents the obvious hazard of a rejected takeoff on a slippery runway. However, an indication of higher than actual thrust can be even more hazardous if a pilot referencing the EPR gage for setting engine thrust attempts to accelerate and take off with insufficient thrust.

Most of these pilots stated that before they attempted takeoff, they had been required to taxi or hold behind other aircraft while awaiting takeoff clearance and that engine thrust levels sufficient for effective anti-icing could not be achieved because of the low coefficient of friction of the taxiway, runup pad, and runway surfaces. Icing problems may occur more often as a result of the more frequent ground delays being experienced during the rebuilding of the ATC system. Therefore, we believe that all flightcrews should be immediately alerted to the dangers of engine inlet pressure probe icing, the effect of anti-ice usage on erroneous thrust indications, the absolute requirement to cross-check all engine instruments during the application of takeoff power, and the importance and significance of the requirements of 14 CFR 121.629(b). 1/

1/ 14 CFR 121.629(b) states, "No person may takeoff an aircraft when frost, snow, or ice is adhering to the wings, control surfaces, or propellers of the aircraft."

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We also believe that FAA tower and ground control personnel should be informed of the greater-than-normal icing potential which exists when an aircraft encounters lengthy ground delays and the potential for thawing and refreezing when an aircraft is required to taxi or hold near another aircraft's engine exhaust. Further, controllers should implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, Paragraph 1232. 2/

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Immediately notify all air carrier operators of the potential hazard associated with engine inlet pressure probe icing, and require that they provide flightcrews with information on how to recognize this hazard and requiring that flightcrews cross-check all engine instruments during the application of takeoff power. (Class I, Urgent Action) (A-82-6)

Immediately review the predeparture deicing procedures used by all air carrier operators engaged in cold weather operations and the information provided to flightcrews to emphasize the inability of deicing fluid to protect against reicing resulting from precipitation following deicing. (Class I, Urgent Action) (A-82-7)

Immediately review the information provided by air carrier operators to flightcrews engaged in cold weather operations to ensure comprehensive coverage of all aspects of such operations, including the effects of a runway contaminated by snow or slush on takeoff, and methods to be used to obtain maximum effectiveness of engine anti-ice during ground operations and takeoffs. (Class I, Urgent Action) (A-82-8)

Immediately require flightcrews to visually inspect wing surfaces before takeoff if snow or freezing precipitation is in progress and the time elapsed since either deicing or the last confirmation that surfaces were clear exceeds 20 minutes to ensure compliance with 14 CFR 121.629(b) which prohibits takeoff if frost, snow or ice is adhering to the wings or control surfaces. (Class I, Urgent Action) (A-82-9)

Immediately issue a General Notice (GENOT) to all FAA tower and air carrier ground control personnel alerting them to the increased potential for aircraft icing during long delays before takeoff and when aircraft operate in proximity to each other during ground operations in inclement weather, and encouraging procedural changes where possible so that the controllers implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, paragraph 1232. (Class I, Urgent Action) (A-82-10)

Document the effect of engine inlet pressure probe blockage on engine instrument readings and require that such information be added to approved aircraft flight manuals. (Class II, Priority Action) (A-82-11)

2/ Paragraph 1232(a) states, "The objective of gate-hold procedures is to achieve departure delays of 5 minutes or less after engine start and taxi time...Implement gate-hold procedures whenever departure delays exceed or are expected to exceed 5 minutes.

Amend Advisory Circulars 91-13c, "Cold Weather Operation of Aircraft," and 91-51, "Airplane Deice and Anti-Ice Systems," to discuss in detail the effects and hazards associated with engine inlet pressure probe icing. (Class II, Priority Action) (A-82-12)

Revise the air traffic control procedures with respect to aircraft taxiing for takeoff, holding in line for takeoff, and taking off to provide for increased ground separation between aircraft whenever freezing weather conditions and attendant aircraft icing problems exist. (Class II, Priority Action) (A-82-13)

Expand the training curricula for air traffic controllers and trainees to assure that instruction includes the hazards associated with structural and engine icing of aircraft. (Class II Priority Action) (A-82-14)

Immediately disseminate the contents of this safety recommendation letter to foreign operators involved in cold weather operations. (Class I, Urgent Action) (A-82-15)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.



By: Jim Burnett  
Acting Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave., S.W.  
Washington, D.C. 20591

January 12, 1982

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-96 issued September 10, 1981, and supplements our letter of October 28, 1981. This also responds to your letter of November 13, 1981, in which you advised the Federal Aviation Administration (FAA) that pending issuance of an Airworthiness Directive (AD), Safety Recommendation A-81-96 would be maintained in an "Open—Acceptable Action" status. The Safety Board's recommendation resulted from your investigation of an incident involving a Piper PA-32R at Raeford, North Carolina, on September 3, 1980. The nose landing gear collapsed during rollout after a normal landing.

A-81-96. Issue an Airworthiness Directive making the provisions of Piper Aircraft Corporation Service Bulletin No. 720 mandatory for all PA-32R series aircraft.

FAA Comment. The FAA issued AD-81-24-07, effective November 20, 1981, which requires modification of the nose landing gear on certain Piper Models PA-32R and PA-32RT series airplanes within 50 hours time in service. A copy of the final rule, as published in the Federal Register (46 FR 56777, November 19, 1981), is enclosed for your information. The FAA considers action on this recommendation completed.

Sincerely,

  
J. Lynn Helms  
Administrator

Enclosure



Office of the Chairman

## National Transportation Safety Board

Washington, D.C. 20594

November 13, 1981

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

Dear Mr. Helms:

Thank you for your letter of October 28, 1981, responding to National Transportation Safety Board Safety Recommendation A-81-96 issued September 10, 1981. This recommendation stemmed from our investigation of an incident involving a Piper PA-32R at Raeford, North Carolina, on September 3, 1980. The nose landing gear collapsed during rollout after a normal landing. A review of accident/incident reports indicated several instances of nose landing gear collapse due to failure of the nose landing gear downlock, P/N 38078-02. We recommended that the Federal Aviation Administration (FAA) issue an Airworthiness Directive (AD) to make the provisions of Piper Aircraft Corporation Service Bulletin mandatory for all PA-32R series aircraft.

The Safety Board is pleased to note that the FAA concurs in this recommendation and will issue an AD as recommended. Pending the issuance of the AD, Safety Recommendation A-81-96 will be maintained in an "Open--Acceptable Action" status.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "James B. King", is written over a circular stamp. The signature is fluid and cursive.

James B. King  
Chairman



US Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave., S.W.  
Washington, D.C. 20591

OCT 28 1981

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-96 issued by the Board on September 10, 1981. This recommendation resulted from the Board's investigation of an aircraft accident caused by a slowly collapsed nose landing gear on a Piper PA-32R, N2252Q, during rollout after a normal landing. This accident occurred at Raeford, North Carolina, on September 3, 1980. The pilot stated that just before touchdown he saw three green landing gear light indications.

Examination of the nose landing gear assembly revealed that the nose landing gear downlock retaining screw, P/N 410011, was loose, worn, and bent. The retaining nut, P/N 404887, had backed off but was still on the threads. This looseness in the retaining nut allowed the eccentric bushing, P/N 35662-02, to rotate and slide. This would randomly result in misalignment of the nose gear downlock, P/N 38078-02, and the downlock bearing (fixed). Although the microswitch could engage and illuminate the green nose gear landing light on the instrument panel, the mechanical downlock would not necessarily be positively engaged.

On April 10, 1981, a Federal Aviation Administration (FAA) Systems Analysis and Summary Report was issued which pointed out that a review of Service Difficulty Reports indicated an upward trend in nose landing gear downlock failures in PA-32R aircraft. There were 18 reports over a 4-year period ending March 5, 1981. Nine of these reports were received during the period April 21, 1980, through March 5, 1981.

In addition, a review of FAA accident/incident reports shows that there have been nine incidents in which the nose landing gear has collapsed due to a failure of the nose landing gear downlock, P/N 38078-02. One incident occurred in 1978, six occurred in 1980, and two occurred in 1981. The cutoff date for these data was March 13, 1981.


A-81-96. Issue an Airworthiness Directive making the provisions of Piper Aircraft Corporation Service Bulletin No. 720 mandatory for all PA-32R series aircraft.

FAA Comment. The FAA concurs in this recommendation. Prior to issuance of Safety Recommendation A-81-96, the Board had been informally advised that Piper's corrective action would be published as Service Bulletin No. 720. However, in subsequent action, on October 2, 1981, the service publication was reidentified and will be published as Service Letter No. 927.

An airworthiness directive (AD) is currently in preparation and will be published to coincide with publication of Piper Service Letter No. 927 and the availability of the associated Service Kit, Piper part number 764-135V. Piper states that the publication and parts availability began during the week of October 12, 1981.

The AD will be published under Docket Number 81-SO-57, and a copy will be forwarded to the Safety Board when published. With issuance of the AD, the FAA considers action completed on Safety Recommendation A-81-96.

Sincerely,

  
J. Lynn Helms  
Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: **SEP 10 1981**

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-96

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On September 3, 1980, the nose landing gear on a Piper PA-32R, N2252Q, slowly collapsed during rollout after a normal landing at Raeford, North Carolina. The pilot stated that just before touchdown he saw three green landing gear light indications.

Examination of the nose landing gear assembly revealed that the nose landing gear downlock retaining screw, P/N 410011, was loose, worn, and bent. The retaining nut, P/N 404887, had backed off but was still on the threads. This looseness in the retaining nut allowed the eccentric bushing, P/N 35662-02, to rotate and slide. This would randomly result in misalignment of the nose gear downlock, P/N 38078-02, and the downlock bearing (fixed). Although the microswitch could engage and illuminate the green nose gear landing light on the instrument panel, the mechanical downlock would not necessarily be positively engaged.

The aircraft records indicated the last annual inspection was accomplished in November 1979 (total aircraft time was 1550.0 hours). The last 100-hour inspection was accomplished on February 23, 1980 (total aircraft time was 1650.0 hours). The total time on the aircraft at the time of the incident was 1,673.84 hours.

On April 10, 1981, a Federal Aviation Administration (FAA) Systems Analysis and Summary Report was issued which pointed out that a review of Service Difficulty Reports indicated an upward trend in nose landing gear downlock failures in PA-32R aircraft. There were 18 reports over a 4-year period ending March 5, 1981. Nine of these reports were received during the period April 21, 1980, through March 5, 1981.

In addition, a review of FAA accident/incident reports shows that there have been nine incidents in which the nose landing gear has collapsed due to a failure of the nose landing gear downlock, P/N 38078-02. One incident occurred in 1978, six occurred in 1980, and two occurred in 1981. The cutoff date for these data was March 13, 1981.

3332

Examination of the Safety Board's briefs of accidents involving Piper PA-32 aircraft where landing gear was a cause/factor (1975-1979) shows no incidents or accidents resulting from failure of the nose landing gear downlock assembly.

The Safety Board is aware that the FAA is currently evaluating a draft of Piper Aircraft Corporation's Service Bulletin No. 720. This draft would announce the availability of a Nose Landing Gear Modification Kit, P/N 764-135V, that when installed will maintain the designed structural integrity and proper function of the nose landing gear downlock system. Compliance with this modification is proposed at the next regularly scheduled inspection event but not to exceed the next 100 hours of operation after the bulletin is issued.

Since the unsafe conditions found on the incident aircraft might be present on other PA-32R aircraft, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Airworthiness Directive making the provisions of Piper Aircraft Corporation Service Bulletin No. 720 mandatory for all PA-32R series aircraft. (Class II, Priority Action) (A-81-96)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

  
By: James B. King  
Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

FEB 6 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-78-5 through A-78-12 issued March 2, 1978, and supplements our previous correspondence on this subject dated May 30, 1978, August 9, 1978, and March 9, 1979. These recommendations resulted from the NTSB's special study, "Emergency Locator Transmitters — an Overview" (NTSB-AAS-78-1). Safety Recommendation A-78-10 was classified in a "Closed—Acceptable Action" status on February 21, 1979. The seven remaining recommendations involved long-term actions and are now addressed individually in this correspondence.

A-78-5. Establish the location(s) and method of mounting an automatic fixed-type ELT in an aircraft so that they will properly operate consistent with the RTCA-SC 127 revised Minimum Performance Standards; include this in the Technical Standard Order which will incorporate the RTCA-SC 127 revised Minimum Performance Standards on ELT's.

A-78-6. Establish the location(s) and method of mounting a fixed-type antenna(ae) externally to an aircraft so that the ELT will properly operate consistent with the RTCA-SC 127 revised Minimum Performance Standards; include this in the Technical Standard Order which will incorporate the RTCA-SC 127 revised Minimum Performance Standards on ELT's.

A-78-8. Include a provision in the Technical Standard Order which will incorporate the RTCA-SC 127 revised Minimum Performance Standards on ELT's requiring that the ELT and battery be readily accessible for visual inspection.

A-78-11. Field test preproduction ELT prototypes supplied by manufacturers to insure that these second-generation ELT's will perform satisfactorily under field conditions and will also meet RTCA-SC 127 Minimum Performance Standards.

A-78-12. Request general aviation aircraft manufacturers that provide preflight checklists with their aircraft, to include in their checklists, the statement "ELT ARMED" in the preflight section and "ELT OFF" in the shutdown and parking section.

FAA Comment. The Radio Technical Commission for Aeronautics Special Committee 136, (RTCA-SC 136) with NASA and Federal Aviation Administration (FAA) participation, is producing a Minimum Operating Performance Standard (MOPS) on ELT installation and performance, and it is also considering the inclusion of aircraft flight manual guidance for ELT procedures. The FAA expects to adopt the minimum performance portion of the MOPS as a revised Technical Standard Order (TSO) for emergency locator transmitters (ELT). In addition, FAA/NASA will develop reports on: (1) guidance material for proper installation of ELT's aboard aircraft; (2) cockpit remote control/monitoring equipment; (3) an improved crash sensor; and (4) recommend parameters for routine ELT inspection. This program is expected to be completed by December 1982, and we believe the efforts are fully responsive to the intent of these five safety recommendations. As second generation ELT's become available, appropriate testing of production samples will be conducted to determine compliance with published performance standards. The FAA will keep the Board informed of significant progress as the program continues.

A-78-7. Study existing and proposed batteries or undertake research to provide a battery or battery system that will provide useful operation of the ELT for at least 50 hours and -40°C and require its use within the second-generation ELT's.

FAA Comment. A study and tests have been conducted by RTCA-SC 136 members to determine if batteries can operate satisfactorily for ELT's at lower temperatures to -40 C. This matter is currently being evaluated by the committee.

A-78-9. Amend 14 CFR 43, Appendix D, to include a separate, specific line item in either the annual or 100-hour maintenance inspection, or both, to require a visual check of the ELT system, including the ELT, battery, antenna or antennae, cockpit control and warning light for indications of problems, including corrosion and improper connections and an operational check of the system.

FAA Comment. The FAA considered rulemaking regarding Appendix D of FAR Part 43 and has determined that the present rules regarding ELT's are adequate. Additionally, a program in the form of a 35mm slide presentation to emphasize proper inspection of ELT's within the framework of existing regulation was instituted. We have found this program to be effective in making the public aware of ELT maintenance requirements. Accordingly, the FAA does not intend to pursue this matter further, and we consider action on Safety Recommendation A-78-9 completed.

Sincerely,



J. Lynn Helms  
Administrator

Enclosures

# EXECUTIVE CORRESPONDENCE



## National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

Dear Mr. Helms:

Please refer to National Transportation Safety Board Safety Recommendations A-78-5 through -12 issued March 2, 1978. These recommendations stemmed from our special study, "Emergency Locator Transmitters -- an Overview" (NTSB-AAS-78-1). We are aware that the Federal Aviation Administration has taken many actions to resolve these old recommendations. However, in order to update our records, we request a current status report.

Sincerely yours,

James B. King  
Chairman

**DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION**

WASHINGTON, D.C. 20591



March 9, 1979

Mr. Frank T. Taylor  
Chief, Bureau of Accident Investigation  
National Transportation Safety Board  
800 Independence Avenue, S. W.  
Washington, D. C. 20594

Dear Mr. Taylor:

In accordance with the discussion of NTSB Safety Recommendation 78-9 in the NTSB/FAA Quarterly Meeting of March 2, we have enclosed copies of the following issuances:

Advisory Circular AC 91-44, "Emergency Locator Transmitters, Operational and Maintenance Practices."

Advisory Circular AC 20-106, "Aircraft Inspection for the General Aviation Aircraft Owner."

Excerpts from Beech, Cessna and Piper manuals which contain references to check and inspection procedures of emergency locator transmitters.

Sincerely,

*J. A. Ferrarese*  
J. A. FERRARESE  
Acting Director  
Flight Standards Service

3 Enclosures



Office of the  
Chairman

## National Transportation Safety Board

Washington, D.C. 20594

February 21, 1979

Honorable Brock Adams  
Secretary  
Department of Transportation  
Washington, D.C. 20590

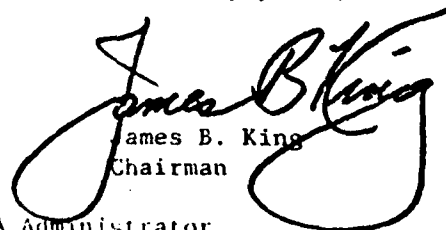
Dear Mr. Secretary:

The National Transportation Safety Board closed the following  
safety recommendations by formal Board action on February 2, 1979:

<u>Addressee</u>	<u>Recommendation</u>	<u>Date Issued</u>	<u>Status</u>
FAA	A-72-219	December 28, 1972	Closed-Acceptable Alternate Action
FAA	A-74-84	October 2, 1974	Closed-Acceptable Action
FAA	A-76-59	January 1, 1976	Closed-Acceptable Alternate Action
FAA	A-76-60	January 1, 1976	Closed-Acceptable Alternate Action
FAA	<u>A-78-10</u>	March 2, 1978	<u>Closed-Acceptable Action</u>

We appreciate the effort put forth by your department toward the  
promotion of transportation safety.

Sincerely yours,

  
James B. King  
Chairman

cc: Honorable Langhorne M. Bond, FAA Administrator  
Mr. Charles R. Foster, Acting Associate Administrator  
for Aviation Standards  
Mr. Marion F. Roscoe, FAA, Director, Office of Aviation  
Safety

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591



OFFICE OF  
THE ADMINISTRATOR

August 9, 1978

Honorable James B. King  
Chairman, National Transportation Safety Board  
800 Independence Avenue, S.W.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to your letter of June 21 requesting reconsideration of the Federal Aviation Administration position as stated in our May 30 response to NTSB Safety Recommendation A-78-9.

A-78-9. Amend 14 CFR 43, Appendix D, to include a separate, specific line item in either the annual or 100-hour maintenance inspection, or both, to require a visual check of the ELT system, including the ELT, battery, antenna or antennae, cockpit control and warning light for indications of problems, including corrosion and improper connections and an operational check of the system.

As stated in our response of May 30, "This was the subject of a regulatory study. After a complete review, we have concluded that the present rules relating to the inspection of ELT's are satisfactory. We do not plan to take any further action at this time."

In your June 21 letter, you mention that FAA Operations Review Proposal Number 61 concerning the amendment of 14 CFR 43, Appendix D, was dropped from the list of proposals. As noted in Operations Review Program Notice Number 4, Notice Number 76-28, 41 FR 56290, the proposal was not dropped but was placed in deferred status. Under the procedures of the Operations Review, the deferral of a proposal does not foreclose the FAA from taking separate rulemaking action on the deferred proposal should need for such action be determined. In addition, since the proposal was not dropped, final disposition of the proposal must be determined prior to completion of the Operations Review Program.

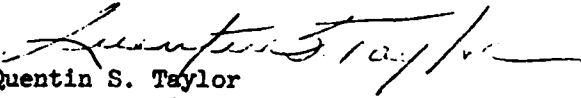
As an alternative to regulatory action recommended in A-78-9, we have initiated an educational program which focuses attention on the inspection and maintenance of ELT equipment.

2

A key feature of this program is a 35mm slide/voice presentation which portrays guidelines for conducting a 100-hour/annual aircraft inspection (copy of voice script enclosed). In this presentation, slide numbers 105-114 are devoted to radio equipment with specific emphasis placed on the ELT by slide number 110. A copy of this presentation has been distributed to each General Aviation District Office where it is made available to mechanic schools, flight schools, accident prevention counselors, and any other interested aviation organizations.

After receipt of your request for reconsideration of Safety Recommendation A-78-9, we reviewed both Proposal Number 61 and 14 CFR 43, Appendix D. We have concluded that, at the present time, the regulations providing for the inspection of ELT equipment are satisfactory.

Sincerely,

  
Quentin S. Taylor  
Deputy Administrator

Enclosure

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591



OFFICE OF  
THE ADMINISTRATOR

May 30, 1978

Honorable James B. King  
Chairman, National Transportation Safety Board  
800 Independence Avenue, S.W.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-78-5 through 12.

A-78-5. Establish the location(s) and method of mounting an automatic fixed-type ELT in an aircraft so that they will properly operate consistent with the RTCA SC-127 revised Minimum Performance Standards; include this in the Technical Standard Order which will incorporate the RTCA SC-127 revised Minimum Performance Standards on ELT's.

Comment. This will be considered by Radio Technical Commission for Aeronautics Special Committee 136 (RTCA SC-136) which has been established to address proposed guidance and instructions for mounting of emergency locator transmitters (ELT's) in aircraft. The first meeting of this Committee was held May 24 and 25. Inclusion of the guidance contained in the SC-127 report in the technical standard order (TSO) is inappropriate. This standard applies to the manufacture of the equipment, exclusively. The method of assurance that equipment will be installed in accordance with the standard as developed by RTCA SC-136 will be determined at a future date.

A-78-6. Establish the location(s) and method of mounting a fixed-type antenna(ae) externally to an aircraft so that the ELT will properly operate consistent with the RTCA SC-127 revised Minimum Performance Standards; include this in the Technical Standard Order which will incorporate the RTCA SC-127 revised Minimum Performance Standards on ELT's.

Comment. This will also be included in the tasks of RTCA SC-136. In addition, we are in the process of determining whether a separate project for development of more crashworthy antennae should be established.

A-78-7. Study existing and proposed batteries or undertake research to provide a battery or battery system that will provide useful operation of the ELT for at least 50 hours and -40°C and require its use within the second-generation ELT's.

Comment. This recommendation is being addressed by our present work in preparing a proposed airworthiness directive and TSO covering the lithium sulfur dioxide battery. We expect to issue the Notice of Proposed Rule Making in September.

A-78-8. Include a provision in the Technical Standard Order which will incorporate the RTCA SC-127 revised Minimum Performance Standards on ELT's requiring that the ELT and battery be readily accessible for visual inspection.

Comment. This has been considered by RTCA SC-127. The Committee decided to incorporate a remote indicator to operate when the ELT is transmitting. This would allow periodic functional checks to be made. However, there may be a conflict between the accessibility of the battery and ELT and the most desirable crashworthiness location. If this is the case, the location, which will assure the highest probability of assurance to activate, will have priority.

A-78-9. Amend 14 CFR 43, Appendix D, to include a separate, specific line item in either the annual or 100-hour maintenance inspection, or both, to require a visual check of the ELT system, including the ELT, battery, antenna or antennae, cockpit control and warning light for indications of problems, including corrosion and improper connections and an operational check of the system.

Comment. This was the subject of a regulatory study. After a complete review, we have concluded that the present rules relating to the inspection of ELT's are satisfactory. We do not plan to take any further action at this time.

A-78-10. Require engineering development and testing of all components which are the subject of standards in the RTCA SC-127 revised Minimum Performance Standards for ELT's, including the crash sensor, to insure that these components perform as specified.

Comment. This is required by Federal Aviation Regulation 37. Each manufacturer is required to perform tests and to supply the data to the FAA before a TSO is approved.

A-78-11. Field test preproduction ELT prototypes supplied by manufacturers to insure that these second-generation ELT's will perform satisfactorily under field conditions and will also meet RTCA SC-127 Minimum Performance Standards.

Comment. This is currently under discussion. A decision with respect to the possible initiation of an FAA research and development program is expected in July.

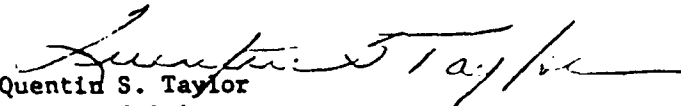
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A-78-12. Request general aviation aircraft manufacturers that provide preflight checklists with their aircraft, to include in their checklists, the statement "ELT ARMED" in the preflight section and "ELT OFF" in the shutdown and parking section.

Comment. When a new TSO is issued and a requirement for a remote monitor/control panel is necessary, such a request will be made.

The meeting of RTCA SC-136, noted above, is the first of 10 or 12 meetings which will be held in the next 18 months. When new standards are established, regulatory action will be undertaken.

Sincerely,

  
Quentin S. Taylor  
Deputy Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: March 2, 1978

-----  
Forwarded to:

Honorable Langhorne Bond  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591  
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SAFETY RECOMMENDATION(S)

A-78-5 through 12

The National Transportation Safety Board has completed a special study, titled "Emergency Locator Transmitters - An Overview," which provides an overview of the current ELT situation. The study was prompted by the large number of false ELT signals and failures to activate during valid distress situations experienced with equipment designed under TSO-C91. For example, data provided by the Air Force Rescue Coordination Center at Scott Air Force Base, Illinois, show that of all the ELT signals reported to it in 1975 and 1976, less than 1 percent resulted in actually locating the crash sites with the aid of an ELT. The overwhelming majority of the ELT signals reported are false. Furthermore, nearly 90 percent of ELT signals emanate from the vicinity of airports.

National Transportation Safety Board data reveal that of 1,028 accident records in 1975 and 1,118 accident records in 1976, the ELT was used in locating the accident site in about 10 percent of these accidents and the ELT malfunctioned in about 30 percent of these accidents. The records further show that about 10 percent of the ELT's were not armed and, therefore, could not have automatically activated upon impact. The remaining records revealed that ELT's which functioned were not used in locating the accident site.

Controversy has surrounded the ELT since 1970 when Congress mandated its installation in most general aviation aircraft. The subsequent difficulties encountered by the ELT have been the subject of numerous studies by organizations concerned with search and rescue. In particular, the Radio Technical Commission for Aeronautics (RTCA), Special Committee 127 (SC 127), was convened at the request of the FAA in January 1975 to revise the Minimum Performance Standards of RTCA DO-145 and DO-147, which were incorporated in TSO-C91. This work has been performed and a draft of the revised specifications completed. The

2265

Safety Board believes that, although these efforts will result in a substantially improved ELT, some of the more persistent ELT systems problems have not been adequately addressed; this combined with insufficient field testing, might result in a second-generation ELT system which will not correct the current unsatisfactory performance of the ELT's. The Safety Board further believes that a well designed, well installed, and properly functioning ELT can be an effective tool in search and rescue.

The study revealed several areas in which corrective action is necessary.

Attachment of ELT -- Attachment of the ELT to the aircraft, including the type of mounting and the location within the aircraft, is a recognized ELT system problem. It is one, however, which the RTCA-SC 127 decided was outside its purview. If improperly mounted the ELT can break free from its mounting system on impact and its coaxial antenna cable can become disconnected. Should the mounting system be too flexible, the system can absorb a significant portion of the impact energy and then the crash sensor may not experience sufficient deceleration force to activate the ELT.

Should the ELT be mounted too far forward, its chances of surviving impact decrease. The unit might experience deceleration forces too severe for it to function properly. The farther aft the ELT is placed, the greater the probability of its survival in a crash if the attachment point withstands the crash forces. However, in typical nose-first impacts, the forward portion of the aircraft absorbs most of the energy of the impact, and if the ELT is mounted too far aft, the ELT may not experience sufficient decelerative forces to activate the crash sensor.

There are no standards that specify the type or location of attachment except for the requirement of the RTCA-SC 127 revised Minimum Performance Standards that the ELT shall have a means of attachment so that the ELT will withstand inertial forces of 100g downward, backward, and sideward and 100g forward and upward without breaking loose from the mounts, damaging the equipment, and causing the ELT to fail to activate. ELT's are attached in numerous locations, from the forward part of the cabin to the rear of the tail cone, and by a variety of mounting methods. Although NASA has performed and is continuing to perform light aircraft crash tests to examine the crash forces experienced at various locations within the aircraft, the mounting problem remains unsolved and virtually unaddressed.

Attachment of antenna -- Another problem area not adequately addressed is that of the attachment to the aircraft of the externally mounted antenna. Often high speed crashes will result in the failure of the antenna. Also, the antenna can be sheared off as the aircraft

descends through trees or other obstructions or by ground obstacles upon impact. Further, if the antenna were covered by wreckage or other debris, the signal would be significantly attenuated.

As in the case of the ELT, there are no standards specifying the attachment of an external antenna to an aircraft. The only requirement is that of the RTCA-SC 127 revised Minimum Performance Standards which require the ELT to be connected to the externally mounted antenna by a suitable RF cable using interlocking connectors. This problem remains unsolved and unaddressed.

Crash sensor -- The crash sensor, which responds to impact forces and activates the ELT when the design level is reached, has caused numerous false alarms and has failed to function when it should have functioned.

Many ELT experts have concluded that the original crash sensor design is, in effect, a vibration sensor. It is extremely sensitive to, and will activate when subjected to, high frequency vibrations. Such vibrations can be transmitted through the airframe when an aircraft experiences external forces, such as those experienced during hard landings, cabin door slamming, turbulence, and strong surface winds. All have been reported to cause unwanted ELT activations.

The crash sensor was a subject of standards in the revised Minimum Performance Standards of RTCA-SC 127. The proposed standards resulted from a study performed by the Crash Research Institute of Tempe, Arizona, which estimates that the current crash sensor will not respond to the deceleration forces in 80 percent of survivable crashes, although it is highly sensitive to vibrations. The CRI also estimates that the proposed standards of the revised Minimum Performance Standards should result in a crash sensor that will activate in 70 percent to 80 percent of these crashes with a small false alarm rate. However, crash sensors have not yet been tested, which leaves doubt as to whether the new design standards will, in fact, solve these persistent problems.

Some model ELT's have had crash sensors which failed to operate because the sensor jams, short circuits, or becomes corroded. Again, field testing of prototype second-generation ELT's will be necessary to determine if these problems have been solved by the redesign of the units.

Battery -- The revised Minimum Performance Standards of RTCA-SC 127 have specified inadequate operating life (50 hours) and low operating temperature (-20°C) for the requirements of search and rescue due in part to current technical limitations of nonlithium type batteries and the hazards associated with the lithium sulfur dioxide battery. Adequate standards for search and rescue are 100 hours operating life at a low temperature of -40°C. This low temperature requirement is absolutely

necessary to insure operation of the ELT during winter in many areas of the United States, particularly in rugged mountainous terrain where rapid rescue is essential for survival of the occupants of a downed aircraft.

Numerous solutions to this problem have been suggested, such as an insulated enclosure to contain the battery or a small heating element to keep the battery warm. A quick disconnect system to enable removal of the battery when the aircraft is not in use could help prevent cold soaking of the battery. Several lithium batteries, including the lithium thionyl chloride and the lithium monofluoride battery, are claimed to hold some promise for eliminating the venting and explosion hazards of the lithium sulfur dioxide battery. The lithium thionyl chloride battery has been tested by one ELT manufacturer, and none of the problems associated with the lithium sulfur dioxide battery have occurred. The Safety Board believes that technical alternatives must be examined and a safe and economical solution to this problem must be found.

Corrosion is another leading cause of battery malfunction. Undetected corrosion can be partially attributed to infrequent inspection. Since batteries are not always readily accessible, inspection is difficult. Batteries should be easily accessible for routine check and the FAR's should specifically require inspection of the battery during the annual or 100-hour maintenance inspection, or both.

Still another problem is failure to replace the battery at the required time. Easy accessibility and required inspections should help to alleviate this problem.

ELT arming and display -- Often, pilots fail to arm the ELT during the preflight check, either inadvertently or because they have become disenchanted or complacent because of the repeated malfunctions. Inclusion of arming as a specific step in the manufacturer's preflight checklist would remind the pilot to take this action before takeoff. This could also serve as a reminder to the pilot to check the remaining shelf life of the battery. The inclusion of the remote control in the cockpit, as proposed in the RTCA-SC 127 revised Minimum Performance Standards, will enable the pilot to easily perform this operation of arming the ELT. One glance at this control switch would enable the pilot to determine whether the ELT is set to "OFF," "MANUAL ON," or "ARMED" for automatic activation.

The problems associated with false alarms could also be alleviated by the remote control and the remote warning light in the cockpit, as required by the revised Minimum Performance Standards. The warning light would alert the pilot of the inadvertent operation of his ELT, and he could then easily silence the malfunctioning ELT with the cockpit control.

These persistent problems can have a negative effect on the national search and rescue program. Much effort has been put into the development of the revised Minimum Performance Standards and it is reasonable to expect that components will be satisfactorily produced in accordance with these new specifications. However, many systems problems that were not addressed remain unanswered. The Safety Board believes that the lack of system engineering and prototype field testing might well result in a second-generation ELT which will not correct the currently unsatisfactory operation of the ELT's.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish the location(s) and method of mounting an automatic fixed-type ELT in an aircraft so that they will properly operate consistent with the RTCA-SC 127 revised Minimum Performance Standards; include this in the Technical Standard Order which will incorporate the RTCA-SC 127 revised Minimum Performance Standards on ELT's. (Class III - Longer Term Action) (A-78-5)

Establish the location(s) and method of mounting a fixed-type antenna(ae) externally to an aircraft so that the ELT will properly operate consistent with the RTCA-SC 127 revised Minimum Performance Standards; include this in the Technical Standard Order which will incorporate the RTCA-SC 127 revised Minimum Performance Standards on ELT's. (Class III - Longer Term Action) (A-78-6)

Study existing and proposed batteries or undertake research to provide a battery or battery system that will provide useful operation of the ELT for at least 50 hours and -40°C and require its use within the second-generation ELT's. (Class III - Longer Term Action) (A-78-7)

Include a provision in the Technical Standard Order which will incorporate the RTCA-SC 127 revised Minimum Performance Standards on ELT's requiring that the ELT and battery be readily accessible for visual inspection. (Class III - Longer Term Action) (A-78-8)

Amend 14 CFR 43, Appendix D, to include a separate, specific line item in either the annual or 100-hour maintenance inspection, or both, to require a visual check of the ELT system, including the ELT, battery, antenna or antennae, cockpit control and warning light for indications of problems, including corrosion and improper connections and an operational check of the system. (Class III - Longer Term Action) (A-78-9)

Require engineering development and testing of all components which are the subject of standards in the RTCA-SC 127 revised Minimum Performance Standards for ELT's, including the crash sensor, to insure that these components perform as specified. (Class III - Longer Term Action) (A-78-10)

Field test preproduction ELT prototypes supplied by manufacturers to insure that these second-generation ELT's will perform satisfactorily under field conditions and will also meet RTCA-SC 127 Minimum Performance Standards. (Class III - Longer Term Action) (A-78-11)

Request general aviation aircraft manufacturers that provide preflight checklists with their aircraft, to include in their check lists, the statement "ELT ARMED" in the preflight section and "ELT OFF" in the shutdown and parking section. (Class III - Longer Term Action) (A-78-12)

BAILEY, Acting Chairman, McADAMS, HOGUE, and KING, Members, concurred in the above recommendations.



By: Kay Bailey  
Acting Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

March 3, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-81-49 through A-81-53 issued by the Board on May 7, 1981, and supplements our letter of August 6, 1981. This also responds to the Board's letter dated November 10, 1981. These recommendations resulted from the Board's investigation of the Beech Baron/Travel Air series of airplanes, and a possible propensity for entering flat spins under conditions of high asymmetric power and low speed.

FAA General Remarks. There has been extended dialogue between FAA and industry on the subject of Baron Minimum Control Speed ( $V_{MC}$ ) and single-engine stall characteristics. In the mid-1970's, a review of accident statistics showed that a significant number of Barons were involved in stall spin accidents which occurred during  $V_{MC}$  and single-engine stall training. At that time, NTSB and Federal Aviation Administration (FAA) personnel cooperated in developing the safe single-engine airspeed ( $V_{SSE}$ ) concept. Their objective was to establish a minimum safe single-engine speed which provides a margin above  $V_{MC}$  to assure availability of control and allow for some variation in techniques which can occur if an unexpected engine shut down or malfunction is experienced, particularly during flight training operations. GAMA subsequently required that a  $V_{SSE}$  be listed in the normal procedures section of the GAMA format flight manuals for small multi-engine airplanes. Safety Recommendations A-81-49 through A-81-53 clearly proceed from an assumption that the pattern of Baron accidents remains the same as it was before 1976. Data available to FAA does not support this assumption. Since 1976, when these new format manuals first became available for the Baron, the stall-spin training accident rate has dropped significantly. We have again reviewed the eight

accidents cited in the Board's letter of November 10, 1981, and find that, contrary to the Board's continued reference to eight flat spin accidents and based on data from the Board's own official accident files, we can classify only the Cumming, Georgia, accident as possibly having resulted from a flat spin. In this accident, it appears that the instructor pilot failed an engine covertly, without briefing and before single-engine work was scheduled for introduction in the syllabus.

The term "flat spin" generally denotes a nonrecoverable spin. We would characterize the other seven accidents as resulting from post stall gyrations which we believe to be recoverable, given sufficient altitude. The Boca Raton accident was observed to result from a spin out of the clouds, followed by recovery from the spin and impact with the ground in a flat attitude, possibly in a secondary stall. In this accident, training was being conducted in an airplane equipped with a single throw-over yoke, which is clearly dangerous and not in accordance with FAA regulations.

The Bear Valley Spring, California, and the Wittier, Alaska, accidents involved out-of-control spinning in instrument meteorological conditions by non-instrument rated pilots. The Turpin, Oklahoma, accident involved an instrument rated pilot and out-of-control spinning after entering clouds on a dark night with strobe, landing, and taxi lights operating. This crash was not a classical stall spin, but is attributed to pilot disorientation due to his having entered low clouds at night with his lights on. (Total flight time was about a minute.) These three accidents were not related to training or practice flights.

The Acuff, Texas, accident appears to have resulted from the introduction of engine cut-offs at speeds below the published  $V_{MC}$ .

The Provincetown, Massachusetts, accident involved extremely steep banks with one engine inoperative and with propeller feathered at extremely low altitude.

The Jarrel, Texas, accident resulted from what may have been practice for approach to landing with one engine inoperative at speeds below published  $V_{MC}$ .

It must be stressed that the above accident circumstance summaries are drawn by FAA review of the data contained in the Board's own official accident files. In our view, all of these accidents can be attributed to either lack of pilot discipline, improper training, practice or operating techniques, or flight in violation of Federal Aviation Regulations. None of these accidents can be attributed to unique single-engine stall characteristics as implied by the Board. More importantly, they indicate no deficiencies in the type certification regulations, and therefore, lend no support to the Board's safety recommendations.

A-81-49. Require that a placard be installed in all Beech Baron/Travel Air aircraft warning of the dangers of and prohibiting intentional single-engine stalls.

FAA Comment. The Board's assumption that the published  $V_{MC}$  is generally below the stalling speed of those airplanes under consideration is invalid. Accordingly, our views, as expressed in our letter of August 6, 1981, remain unchanged. Further, we are unable to accept the Board's reasoning that a placard installation has greater impact on the pilot than the far more extensive and effective compilation of FAA and manufacturer cautions, explanations, and warnings. We do know, however, that the more placards that are installed in aircraft, the less impact each one has on the pilot. While the FAA welcomes additional information that would quantify the advantage of such a warning placard, there simply is insufficient data held by the FAA to validate such an advantage. Accordingly, the FAA considers action completed on Safety Recommendation A-81-49.

A-81-50. Amend 14 CFR 23.205, "Critical Engine Inoperative Stalls," to make the test requirements more rigorous with regard to the potential detection of an airplane's propensity to display any undue spinning tendency.

FAA Comment. The FAA finds that application of more rigorous test requirements to §23.205 would be unrealistic and impractical. In our judgment, more severe requirements cannot be justified and would only confirm what we already know: that the airplane, like all light twins, is likely to encounter a dangerous condition. Spinning of twin engine airplanes is not practical and is dangerous. National Aeronautics and Space Administration's tests to date confirm that the phenomena of spin and recovery are the least quantified part of the flight spectrum. The most effective way to cope with this situation is to avoid the circumstances that lead to these conditions. We believe that the tests prescribed in §23.205 and the test procedures described in FAA Order 8110.7, requiring compliance with §23.205 and §23.149, are adequate to determine whether or not an airplane possesses undue spinning tendencies.

The FAA, we believe, has pursued the most effective approach to solving the stall/spin problem. We have emphasized training rather than pursuing action through the type certification process. We have emphasized stall warning and recovery. Pilots must be trained to avoid flight attitudes and conditions that may result in an inadvertent stall and spin. We contend that the approach most beneficial to the pilot is to place emphasis on stall avoidance, education, and discipline, to observe a safe single-engine speed.

Pilot training in multi-engine airplanes is designed to assure that applicants for a multi-engine rating have experienced the effects on control forces necessary to maintain flight at reduced airspeeds during single-engine operations. To ensure that this objective is met, we have undertaken a review of pilot training procedures to ensure that our advisory circular material does not lead a pilot to proceed beyond the limits at which safety is assured by the airplane type certification. This review is general in nature, but we expect that any benefits should also accrue to the Baron.

A-81-51. Require Beech Aircraft Corporation to disseminate information relating to Beech Baron/Travel Air single-engine stall speeds, including graphical or other information showing the operational conditions and limits wherein flight at the published value of  $V_{MC}$  is not possible.

FAA Comment. The Safety Board's critique proceeds from the assumption that published  $V_{MC}$  is generally below stalling speed, when in fact it is not. We are unable to concur in the statement appearing in the Beechcraft Safety Communique of April 26, 1976, that  $V_{MCA}$  is below power-off stall speed for most operating weights and altitudes. This disagreement results from the difference between published  $V_{MC}$ , which is a limitation, and the actual  $V_{MC}$  for specific weights and altitudes, which is lower than the published  $V_{MC}$ .

For this reason, and in concert with discussions in our letter of August 6, 1981, we consider action completed on Safety Recommendation A-81-51.

A-81-52. Convene a special certification review team to explore and evaluate the relative margins of safety of the Beech Baron in low-speed, high power, single-engine operations for all conditions which may be realistically anticipated in a multiengine, pilot-training environment.

FAA Comment. We believe this recommendation is addressed in our general remarks stated earlier in this letter. The FAA's discussion of August 6, 1981, is also relevant. Accordingly, the FAA considers action completed on Safety Recommendation A-81-52.

A-81-53. Require that all Beech Baron/Travel Air aircraft be retrofitted with aerodynamic air flow kits or components designed to alleviate their hazardous single-engine stall characteristics. Relative to the retrofit, Beech Aircraft's stall research program should provide for prompt development of appropriate hardware, rigging of controls, and/or other necessary modifications.

FAA Comment. Single-engine stall characteristics, as such, have not been established as a cause in any of the eight Baron/Travel Air accidents described by the Safety Board. As we stated previously, this recommendation does not appear to have a sound basis relative to the accident reports under consideration. Consistent with the views expressed in FAA's letter of August 6, 1981, the FAA will monitor Beech Aircraft progress in stall research. When stall improvement hardware is available, we will proceed according to the dictates of service history to require whatever retrofit may be deemed necessary and appropriate in the public interest. No immediate action is contemplated on Safety Recommendation A-81-53.

It is clear, from a review of our extensive correspondence on these issues, that there has been and may still exist some basic misunderstandings related to definitions and terminology in this highly complex technical area. I believe that our staffs would benefit from a face-to-face discussion of the issues. To that end, I have asked our Director of Aviation Safety to contact your staff to arrange such a meeting at a mutually convenient time.

Sincerely,

  
J. Lynn Helms  
Administrator



## National Transportation Safety Board

Washington, D.C. 20594

November 10, 1981

Office of the Chairman

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

Dear Mr. Helms:

This is in response to your letter of August 6, 1981, regarding National Transportation Safety Board Safety Recommendations A-81-49 through -53. These recommendations were issued on May 7, 1981, and relate to spin accidents involving Beech Baron/Travel Air airplanes.

### General Remarks

The Safety Board does not believe that your response adequately addresses any of the above recommendations, particularly when inquiries and probes by parties other than the Safety Board, including a Federal Aviation Administration (FAA) Flight Standards District Office, reflect concerns identical to ours.

Our review of Beech Baron/Travel Air accidents for the period 1975 through 1980 clearly indicates that flat spin accidents involving these aircraft continue to occur and that this problem has not yet been adequately treated. The eight flat spin accidents in our recommendation letter were referenced in order to put this matter in proper chronological perspective and to show the continuing propensity of the aircraft for flat spin involvement. These spin accidents are as follows:

<u>Date</u>	<u>Location</u>	<u>Model</u>	<u>Registration</u>
3-30-78	Bear Valley Spring, CA	Beech 95-B55	N718X
5-20-78	Provincetown, MA	Beech 95-B55	N514Q
8-13-78	Near Wittier, AK	Beech 95-B55	N1078W
1-12-79	Near Acuff, TX	Beech 95-B55	N6032F
3-02-79	Near Turpin, OK	Beech BE-58P	N6050S
3-21-79	Jarrel, TX	Beech 95-B55	N8126R
4-15-79	Near Boca Raton, FL	Beech 58	N20SB
2-19-80	Cumming, GA	Beech 95-B55	N88LR

Neither Federal Aviation Regulation (FAR) 23.205, "Critical Engine Inoperative Stalls," nor the earlier regulation, Civil Air Regulation (CAR) 3.123, tests for undue spinning tendencies in the course of demonstrations of minimum control speed ( $V_{mc}$ ). Consequently, despite the 1976 revalidation tests of the Beech Baron in respect to compliance with CAR 3.123, the Board does not agree with the FAA's position that no undue spin tendencies exist. More importantly, the accident record simply doesn't support such a position.

You indicate in your letter, and the Safety Board agrees, that " $V_{mc}$  should not be demonstrated when the  $V_{mc}$  is known or discovered to be close to stalling speed." However, you also indicate that "except for a few extreme conditions, there are very few situations where the published  $V_{mc}$  cannot be achieved prior to reaching stall, with power settings within the normal operating envelope." The Safety Board does not agree with this statement because it is contrary to information supplied by the manufacturer. An excerpt from a 1976 Beechcraft Executive Airplane Safety Communique applicable to Baron/Travel Air aircraft, for example, indicates:

These airplanes have the desirable characteristic of having a  $V_{MCA}$  (Minimum Control Speed) which is below power off stall speed for most operating weights and altitudes. The FAA Flight Test Guide (AC 61-4C) recognizes this situation in the Engine-Out Minimum Control Speed Demonstration portion by stating that in this case "...an effective flight demonstration (of  $V_{MCA}$ ) is impossible and will not be attempted."

A-81-49 - Require that a placard be installed in all Beech Baron/Travel Air aircraft warning of the dangers of and prohibiting intentional single-engine stalls.

Any attempt to demonstrate minimum control speed in the Beech Baron/Travel Air aircraft will likely be precluded by a stall. Since some pilots, including instructors, may not be aware of this inherent constraint in attaining  $V_{mc}$ , the Safety Board continues to believe that the installation of a placard warning of this potentially hazardous single-engine stall situation is merited. This is particularly true in a training environment where relatively inexperienced student pilots are involved recurrently in operating the aircraft at low speeds.

A-81-50 - Amend 14 CFR 23.205, "Critical Engine Inoperative Stalls," to make the test requirements more rigorous with regard to the potential detection of an airplane's propensity to display any undue spinning tendency.

The Safety Board does not agree with your surmise that compliance with this recommendation might lead to unrealistic and impractical requirements. Indeed, the current regulations are already unrealistic and impractical since FAR 23.205 is not compatible with FAR 23.149, "Minimum Control Speed." These requirements, as explained in our recommendation letter of May 7, 1981, should be consistent with respect to test provisions and conditions. When testing for undue spinning tendencies, it is a matter of fundamental engineering to incorporate certain critical parameters in the test such as asymmetric takeoff, maximum available power, or windmilling propeller. Since this is not done in tests to show compliance with FAR 23.205, a regulatory gap exists between this section and FAR 23.149 in connection with critical  $V_{mc}$  demonstrations wherein the potential for unintentional spins is relatively high.

A-81-51 - Require Beech Aircraft Corporation to disseminate information relating to Beech Baron/Travel Air single-engine stall speeds, including graphical or other information showing the operational conditions and limits wherein flight at the published value of  $V_{mc}$  is not possible.

In addition to misinterpreting the intent of this recommendation, your response disregards published information regarding minimum control speeds in these aircraft. Since  $V_{mc}$  cannot generally be achieved in Beech Baron/Travel Air airplanes before reaching stall, a  $V_{mc}$  demonstration is impossible and according to the FAA Flight Test Guide (AC 61-55A) should not be attempted. Perhaps  $V_{mc}$  demonstrations in these airplanes should be prohibited altogether; if not, the Board knows of no reason why pilots should not be given the information necessary for them to determine the conditions under which such a demonstration should not be undertaken.

A-81-52 - Convene a special certification review team to explore and evaluate the relative margins of safety of the Beech Baron in low-speed, high-power, single-engine operations for all conditions which may be realistically anticipated in a multiengine, pilot-training environment.

The above recommendation centers about CAR 3.106 (controllability) and CAR 3.10 (eligibility for type certificate). The former (in part) states:

. . . It shall be possible to make a smooth transition from one flight condition to another, including turns and slips, without requiring an exceptional degree of skill, alertness, or strength on the part of the pilot, and without danger of exceeding the limit load factor under all conditions of operation probable for the type, including for multi-engine airplanes those conditions normally encountered in the event of sudden failure of any engine. . . .

CAR 3.10 indicates:

An airplane shall be eligible for type certification under the provisions of this part if it complies with the airworthiness provisions hereinafter established or if the Administrator finds that the provision or provisions not complied with are compensated for by factors which provide an equivalent level of safety. Provided, that the Administrator finds no feature or characteristic of the airplane which renders it unsafe for the category in which it is certificated.

The long term stall/spin accident history of the Beech Baron/Travel Air airplanes together with the NTSB investigations relating thereto indicates the potential existence of undue spinning tendencies. Consequently, we believe it is now incumbent upon FAA to resolve this issue through special certification review or reevaluation procedures. A certification review team, for example, should ascertain whether or not stall/spin characteristics, which may have been discovered subsequent to certification, are compatible with the broader intent of CAR 3.106 and CAR 3.10.

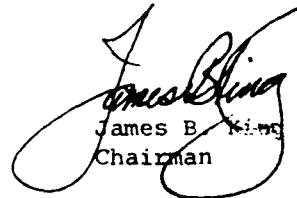
A-81-53 - Require that all Beech Baron/Travel Air aircraft be retrofitted with aerodynamic air flow kits or components designed to alleviate their hazardous single-engine stall characteristics. Relative to the retrofit, Beech Aircraft's stall research program should provide for prompt development of appropriate hardware, rigging of controls, and/or other necessary modifications.

The Safety Board disagrees with FAA's position that there is no information at this time on which to base a mandatory retrofit, and we reject the suggestion that there is need to further study the problem of flat spin accidents in Beech Baron/Travel Air airplanes before requiring that they be retrofitted with aerodynamic air flow kits or components. You indicate that when such hardware becomes available the FAA will "proceed in accordance with the dictates of service history." The accident record/service history relating to spins involving these aircraft is quite clear and explicit and the only further matter that FAA needs to resolve has to do with the development of appropriate hardware to retrofit these aircraft.

The Safety Board is pleased to note that the Beech Aircraft Corporation has initiated a research program relating to single-engine stalls. This program, which utilizes a Beech Baron Model 58P/TC aircraft, is aimed at reducing the inherent roll rates of light, twin-engine aircraft in a single-engine, fully stalled condition through the application of new NASA research concepts. It is essential that the FAA undertake a lead role in this program and require retrofit of Beech Baron/Travel Air aircraft as soon as appropriate hardware or components become available.

In view of the above, the Safety Board requests that FAA reevaluate NTSB Recommendations A-81-49 through A-81-53. These recommendations are being held in an "Open--Unacceptable Action" status pending your further response.

Sincerely,



James B. King  
Chairman



US Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

100 Independence Ave. S.W.  
Washington, D.C. 20591

August 6, 1981

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-49 through A-81-53 issued by the Board on May 7, 1981. These recommendations resulted from the Board's investigation of the Beech Baron/Travel Air series of airplanes, involving a propensity for entering flat spins under conditions of high asymmetric power and low speed.

FAA General Remarks: The text of the Board's recommendations states that there were eight fatal accidents between March 1978 and March 1980 involving Beech aircraft, where flat spins occurred under conditions of high asymmetric power and low speed. A review of the Federal Aviation Administration (FAA) records for the period April 1976 to January 1979 indicates that no spin accidents occurred in Baron airplanes which could be attributed to the practice of  $V_{mc}$  maneuvers. From January 1979 to the present, two training accidents have occurred which could possibly be attributed to the practice of  $V_{mc}$  maneuvers. In one instance, the training was being conducted in an airplane equipped with a single throw-over yoke, not in accordance with applicable Federal Aviation Regulations (FAR) requirements. In the other case, it appears highly probable that engine cut-offs were introduced at speeds below the published  $V_{mc}$  and at low altitude in order to test student reactions.

In 1976, in response to earlier NTSB safety recommendations, Beech Aircraft Corporation and the FAA participated jointly in a test program to revalidate findings of compliance with Civil Air Regulation (CAR) 3.123. The results were satisfactory and it was concluded that, as required by the applicable regulations, no undue spinning tendency existed. The introduction of the concept of  $V_{sse}$  (intentional one engine inoperative speed) in 1976 provided an additional safety margin above  $V_{mc}$  and  $V_s$  to minimize the potential hazard associated with  $V_{mc}$  and single-engine stall demonstrations and training. It should be noted that FAA policy has historically advised that single-engine stalls will not be demonstrated on multi-engine flight tests, and should not be practiced in high performance airplanes by other than qualified engineering test pilots. Additionally,  $V_{mc}$  should not be demonstrated when the  $V_{mc}$  is known or discovered to be close to

stalling speed. These established training and flight test limitations, coupled with the extensive safety information concerning one-engine inoperative flight procedures included in the Beech Aircraft Flight Manuals and Pilot Operating Handbooks, are still considered adequate to ensure safe operation of the airplane in all authorized flight regimes. Additional information concerning stalls and single-engine operation of light twin-engine aircraft is contained in Advisory Circular (AC) 61-54, Flight Test Guide - Private Pilot Airplane, and in AC 61-21A, Flight Training Handbook. The FAA does not consider it advisable to dictate design of, or impose limitations on, a particular airplane, whereby complete safety would be assured despite a flagrant disregard of regulations or extreme cases of poor airmanship.

A-81-49. Require that a placard be installed in all Beech Baron/Travel Air aircraft warning of the dangers of and prohibiting intentional single-engine stalls.

FAA Comment. We agree that the practice of demonstrating single-engine stalls with high asymmetric power in the light twin-engine airplane training environment is potentially a high risk maneuver. Additionally, the demonstration of actual  $V_{mc}$  speeds below the published  $V_{mc}$  should be avoided except by qualified engineering test pilots in a test environment.

The problems which relate to the conduct of single-engine stalls are common to all high-performance light twin-engine airplanes and differ only in a matter of degree, so that the post-stall characteristics and  $V_{mc}$  handling qualities of a particular airplane are elements inseparable from basic knowledge and training requirements. The same problems exist in transport category airplanes where accepted training procedures are considered adequate to avoid the hazards associated with single-engine stalls or  $V_{mc}$  characteristics. We believe the level of basic knowledge is adequate, and the training appropriate, and therefore find that a warning is unnecessary. Accordingly, we do not believe it is appropriate to prohibit selectively intentional single-engine stalls in the Beech Baron/Travel Air series airplane, and the FAA considers action completed on Safety Recommendation A-81-49.

A-81-50. Amend 14 CFR 23.205, "Critical Engine Inoperative Stalls," to make the test requirements more rigorous with regard to the potential detection of an airplane's propensity to display any undue spinning tendency.

FAA Comment. The FAA contends that the formulation of requirements more rigorous than those set forth in FAR Part 23.205, such as requirements for higher thrust on the operative engine, additional airplane configuration testing, altitude testing, etc., could lead to unrealistic and impractical requirements.

The provisions of Part 23.205 were revised by Amendment 3-7, requiring one-engine inoperative stall characteristics that preclude unintentional spin entry. This requirement was found to be impractical, and the substance of the prior effective rule was reinstituted by Amendment 23-3, resulting in essentially the same provisions as Part 23.205, which is currently effective.

In view of the foregoing, we do not believe it is appropriate to establish more rigorous one-engine inoperative stall requirements, nor do we believe it productive to expand the flight test regime for testing of one-engine inoperative stall/spin characteristics at this time. Moreover, we doubt that the more rigorous stall/spin criteria would help to reduce stall/spin accidents. Such testing might only induce pilots to attempt spinning airplanes, with a resultant increase in stall/spin accidents, even though operating limitations prohibit intentional spins. The entire philosophy of the type certification and training requirements is based on the avoidance of spins in an operational environment. We believe this philosophy of avoidance is the more reasonable and fruitful approach toward resolving this problem. We will continue to follow stall/spin research in progress, and, if developments indicate changes to the regulations are required, we will take appropriate action. We do not plan to pursue this issue further, and, accordingly, the FAA considers action completed on Safety Recommendation A-81-50.

A-81-51. Require Beech Aircraft Corporation to disseminate information relating to Beech Baron/Travel Air single-engine stall speeds, including graphical or other information showing the operational conditions and limits wherein flight at the published value of  $V_{mc}$  is not possible.

FAA Comment. This problem appears to be associated with conditions where flight demonstrations involve speeds well below the published  $V_{mc}$ . The FAA believes that any attempt to provide the information suggested in this recommendation could mislead airplane operators and, in fact, be counter-productive. We are concerned that it may appear to condone training activities at speeds which have not been investigated during the certification process.

Regulations require that stalls be investigated with one engine inoperative under specified conditions: critical engine inoperative, flaps and landing gear retracted, and remaining engine(s) operating at 75 percent maximum continuous power. Satisfactory characteristics in the specified configuration do not necessarily coincide with those in the configuration required for demonstration of  $V_{mc}$ . This confusion, in itself, may negate any benefit resulting from publication of the recommended information. Additionally, we are concerned that such information could be too complicated to achieve its intended purpose. Except for a few extreme conditions, there are very few situations where the published  $V_{mc}$  cannot be achieved prior to reaching stall, with power settings within the normal operating envelope.

In consideration of the foregoing, no further action on Safety Recommendation A-81-51 will be pursued.

A-81-52. Convene a special certification review team to explore and evaluate the relative margins of safety of the Beech Baron in low-speed, high-power, single-engine operations for all conditions which may be realistically anticipated in a multiengine, pilot-training environment.

FAA Comment. The use of a Special Certification Review team to explore and evaluate the relative safety margin of the Beech Baron airplane, specifically, is not considered appropriate. The "relative safety margin" must be determined by comparison to some standard, norm, or specification. If the specification used is the FAA regulation that pertains to the certification aspects

of the problem, then compliance has been satisfactorily shown to the extent that the airplane does not "possess any undue spinning tendency" when operated within the established limitations and approved envelope. In reference to conditions of flight that may be reasonably anticipated in a multi-engine, pilot-training environment, we find that existing regulations, policies, and standard operating procedures are adequate to provide an appropriate level of safety, provided these standards are adhered to.

If the "relative safety margin" is intended to mean a comparison between selected light twin-engine airplanes and their individual degree of freedom from undue spinning tendency, then this involves the same questions discussed in our response to A-81-49, -50, and -51. Each airplane has its own unique flight characteristics and must be judged against a minimum standard established by regulation. However, only insofar as reestablishing a new minimum standard would a direct comparison of two or more airplanes be productive. Accordingly, we do not intend to convene a special certification review team and the FAA considers action completed on Safety Recommendation A-81-52.

A-81-53. Require that all Beech Baron/Travel Air aircraft be retrofitted with aerodynamic air flow kits or components designed to alleviate their hazardous single-engine stall characteristics. Relative to the retrofit, Beech Aircraft's stall research program should provide for prompt development of appropriate hardware, rigging of controls, and/or other necessary modifications.

FAA Comment. The NTSB is aware of the stall research program which studies the potential for moderating the inherent roll rates of conventional light twin-engine aircraft in single-engine, fully stalled conditions. This is a relatively long-term project, and the FAA's Central Region is monitoring Beech Aircraft's progress in this endeavor. Additionally, we will encourage Beech Aircraft to proceed without delay in the development of any hardware to modify their airplanes, resulting in improved single-engine stall characteristics.

When such hardware becomes available, the FAA will proceed in accordance with the dictates of service history to require such retrofit as deemed necessary and appropriate. We have no information at this time on which to base a mandatory retrofit and, therefore, no immediate action is contemplated on Safety Recommendation A-81-53.

Sincerely,



J. Lynn Helms  
Administrator

# NATIONAL TRANSPORTATION SAFETY BOARD

## WASHINGTON, D.C.

ISSUED: May 7, 1981

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-49 through -53

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For the past several years, the Beech Baron/Travel Air series of airplanes have demonstrated a propensity for entering flat spins under conditions of high asymmetric power and low speed. Between March 1978 and March 1980, there were eight fatal accidents of this type. The accident at Cumming, Georgia, on February 19, 1980, involving a Beech 95-B55 typifies the operational circumstances of most of these accidents. The instructional flight was the second in a multiengine course involving single-engine operation and the demonstration of minimum control speed. The pilot trainee, the only survivor, recalls attempting to move his body as far forward as possible during the spin in order to bring the nose of the airplane down. Witnesses saw the aircraft spinning with the tail lower than the nose.

The involvement of Beech Baron/Travel Air airplanes in flat spin accidents is not a new problem nor one that has just recently emerged. The Safety Board has previously sent five safety recommendations (A-75-64 and A-76-97 through -100) to the Federal Aviation Administration (FAA) regarding this subject. The Safety Board believes that had the FAA complied with these recommendations some of these accidents may have been prevented.

Based on the circumstances of these accidents, the Safety Board concludes that training for a potential emergency in Beech Baron/Travel Air airplanes, such as an engine-out condition, may be more hazardous than the emergency itself. For some conditions of airplane gross weight and altitude, the single-engine stall speeds of the aircraft are greater than the single-engine minimum control speeds (V<sub>mc</sub>). Consequently, when pilots, including instructor pilots, attempt to demonstrate V<sub>mc</sub> or loss of directional control, they may unexpectedly encounter a single-engine stall. At high asymmetric power, the stall in these airplanes is abrupt and is accompanied by rapid rolling to an inverted or near inverted position, followed by entry into a flat spin.

While one could take the position that pilots should be more careful and recover the airplane before this loss-of-control situation develops, the Safety Board believes that such a position is tenuous. The Beech Baron flat-spin accident record, coupled with the fact that some of the instructor pilots involved were highly experienced in Beech aircraft, tends to confirm that the situation demands above-average pilot skill and alertness.

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The single-engine stall characteristics of these aircraft, under the above circumstances, create an undue tendency to spin that is not measured or tested under 14 CFR 23.205, "Critical Engine Inoperative Stalls." Tests under this part, for example, involve: (1) only 75 percent maximum continuous power, or less, rather than takeoff or maximum available power used in Vmc demonstrations; (2) a feathered propeller rather than a windmilling propeller; and (3) minimal sideslip. This regulation, when scrutinized, is relatively weak insofar as detection of undue spinning tendencies is concerned.

In any event, the airplane is not safely controllable or maneuverable under the high asymmetric power conditions and other adverse factors that are routinely related to the demonstration of Vmc. With high asymmetric power, rolloff at the stall constitutes an unsafe feature that is not compatible with intended usage in a multiengine training environment.

The U.S. Army in a 1974 report, "T-42A Single-Engine Performance and Stall Investigation," described the single-engine (asymmetric) power on stalls of the Beech Model B55B as violent and potentially catastrophic. The following excerpts from that report detail these characteristics:

The stall characteristics with single-engine power on are considerably more severe than those for symmetrical power conditions. Single-engine power-on stall is characterized by a rapid roll toward the inoperative (dead) engine. If not immediately arrested, this roll progresses rapidly into a wing-over or split-S entry into an upright spin. Vigorous and immediate recovery action is required.

Instantaneous Recovery Action. When recovery was initiated immediately at stall, a rapid forward movement of the elevator control normally arrested the roll rate and regained control of the aircraft. Full rudder control opposite to the direction of roll was normally already applied since stall occurs below Vmc. If full rudder had not been previously initiated, it was applied concurrently with the forward elevator control. If these combined actions did not arrest the roll rate, power was reduced on the operative (good) engine. Recovery was normally from a large bank angle (approaching 90 degrees), nose-down attitude which results in a steep, diving pullout. Rapidly increasing airspeed during the pullout exceeded the airframe limits for the landing gear and flaps requiring these items to be retracted. Extreme care was necessary during the pullout to avoid a high-speed, accelerated stall.

Delay Recovery Action (1 second delay). When any delay in recovery action was allowed at full stall, the roll rate increased rapidly. Virtually full forward movement of the elevator control and complete power reduction on the operative engine was required for recovery. Recovery following a slight delay (1/4 to 1/2 second) was from a split-S or complete wing-over maneuver. With slightly longer delays (approaching 1 second) the wing-over progresses immediately into an upright spin. The considerations discussed above concerning rapidly building airspeed and avoidance of a high-speed, accelerated stall likewise apply for the delayed recovery.

In 1976, the operational concept of a safe single-engine speed (Vsse) was introduced to alleviate the adverse dynamic effects of an intentional engine-out at or close to either Vmc or the single-engine stall speed. Subsequently, the FAA disseminated information regarding Vsse and proper engine inoperative procedures through flight training clinics, pilot safety seminars, and flight instructor refresher courses. Any beneficial effects, however, were short-lived as evidenced by the increasing number of Beech Baron flat-spin accidents. The Safety Board believes that, in addition to pilot education, positive effort is needed to resolve any existing undue spinning tendencies during critical engine-inoperative stalls of this as well as similar aircraft which may be certificated in the future.

In October 1980, the Beech Aircraft Corporation initiated a stall research program to study the potential for moderating the inherent roll rates of conventional light twin-engine aircraft in single-engine, fully stalled conditions. Beech anticipates that this two-phase wind tunnel/flight test program will take at least 18 months to complete. While Beech's stall research program is commendable, the Safety Board does not believe that it is adequately expedient in resolving the involvement of Beech airplanes in flat-spin accidents.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that a placard be installed in all Beech Baron/Travel Air aircraft warning of the dangers of and prohibiting intentional single-engine stalls. (Class II, Priority Action) (A-81-49)

Amend 14 CFR 23.205, "Critical Engine Inoperative Stalls," to make the test requirements more rigorous with regard to the potential detection of an airplane's propensity to display any undue spinning tendency. (Class II, Priority Action) (A-81-50)

Require Beech Aircraft Corporation to disseminate information relating to Beech Baron/Travel Air single-engine stall speeds, including graphical or other information showing the operational conditions and limits wherein flight at the published value of Vmc is not possible. (Class II, Priority Action) (A-81-51)

Convene a special certification review team to explore and evaluate the relative margins of safety of the Beech Baron in low-speed, high-power, single-engine operations for all conditions which may be realistically anticipated in a multiengine, pilot-training environment. (Class II, Priority Action) (A-81-52)

Require that all Beech Baron/Travel Air aircraft be retrofitted with aerodynamic air flow kits or components designed to alleviate their hazardous single-engine stall characteristics. Relative to the retrofit, Beech Aircraft's stall research program should provide for prompt development of appropriate hardware, rigging of controls, and/or other necessary modifications. (Class II, Priority Action) (A-81-53)

In addition, the National Transportation Safety Board reiterates our previous recommendation that the Federal Aviation Administration:

Issue an Advisory Circular dealing solely with simulated and actual engine-out emergencies in typical high performance, multiengine general aviation airplanes. (Class II - Priority Action) (A-75-64)

This Circular, aside from providing general operational guidelines and technical information, should supplement present FAA Advisory Circular 61-67, "Hazards Associated With Spins in Airplanes Prohibited From Intentional Spinning," by placing special emphasis on the potentially catastrophic and often irreversible situations which may develop, such as the flat spin, if a loss of control is allowed to occur. This information should be mailed directly to all pilots holding multiengine class ratings, distributed to fixed base operators and flight schools, and disseminated among the various flight instructor clinics and safety seminars held throughout the year. In addition, the FAA's Accident Prevention Staff should, where feasible, discuss operational details with recipients to assure that the objectives of the Circular are thoroughly understood.

KING, Chairman, DRIVER, Vice Chairman, McADAMS and GOLDMAN, Members, concurred in these recommendations. BURSLEY, Member, did not participate.

By:   
James B. King  
Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington D.C. 20591

February 23, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-79-85 issued November 19, 1979, and supplements our letter of February 15, 1980. This also responds to your letter of March 21, 1980. This recommendation resulted from the Board's investigation of a Sikorsky S-61L helicopter crash at Newark International Airport, Newark, New Jersey, on April 18, 1979.

A-79-85. Issue an Airworthiness Directive to require a one-time ultrasonic inspection of tail rotor blades installed on S-58 and S-58T model helicopters for evidence of spar cracks and, if necessary, establish a recurring spar inspection based on an appropriate number of operating hours.

FAA Comment. The Federal Aviation Administration (FAA) agrees that the S-58 and S-61 tail rotor blade structure is similar; however, the tail rotor speed and resultant stresses are lower for the S-58. Accordingly, the blades do not operate under the same load environment, creating a situation requiring careful consideration. For instance, a comparison of the vibratory stresses at the shank of the tail rotor blades for a representative range of high speed level flight conditions indicates that the S-58 stresses are only 75 percent of the equivalent stresses for the S-61. The tail rotor blades of the S-58 have been substantiated for safe life and therefore are required to be replaced after specified service time. This substantiation is not dependent upon inspections of the blades. With the safety life substantiation of the blades and their extensive service experience, there is no technical basis for requiring additional inspections of the blades.

Tail rotor blades are susceptible to foreign object damage; the rapidly turning blades are likely to be struck by debris lifted by the airflow from the main rotor. Repetitive inspection of these blades is advisable and Sikorsky has issued precautionary service bulletins requiring visual and dye penetrant inspections of the tail rotor blades of S-58 and S-58T aircraft. We agree that these inspections are reasonable precautionary measures.

Sikorsky S-58 helicopters are operated by companies that are smaller than those that operate S-61 helicopters, and a requirement for ultrasonic inspection would place an undue burden on these smaller operators. Ultrasonic inspection requires involvement by inspectors experienced in the techniques of operating ultrasonic equipment and having access to this specialized equipment. Furthermore, some tail rotor blades have abrasion strips installed, thus complicating the inspection procedures. We believe these burdens are unwarranted under present circumstances.

The S-61 series helicopters have accumulated over 20 million hours of service with only one spar failure, and no additional failures have been detected through mandatory inspections. Statistically, this indicates the S-61 spar failure was a random occurrence, and should not be the sole basis for conclusions regarding the probability of S-58 tail rotor blade failure.

On the basis of this investigation and our in-depth review, the FAA plans no further action relative to this matter and we consider action completed on Safety Recommendation A-79-85.

Sincerely,



J. Lynn Helms  
Administrator



Office of  
Chairman

## National Transportation Safety Board

Washington, D.C. 20594

March 21, 1980

Honorable Langhorne M. Bond  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

Dear Mr. Bond:

Reference is made to your letter dated February 15, 1980, responding to the National Transportation Safety Board's Safety Recommendation A-79-85. This recommendation stemmed from the Safety Board's investigation of a Sikorsky S-61L helicopter accident at Newark International Airport, Newark, New Jersey, on April 18, 1979. We recommended that the Federal Aviation Administration (FAA):

"Issue an Airworthiness Directive to require a one-time ultrasonic inspection of tail rotor blades installed on S-58 and S-58T model helicopters for evidence of spar cracks and, if necessary, establish a recurring spar inspection based on an appropriate number of operating hours."

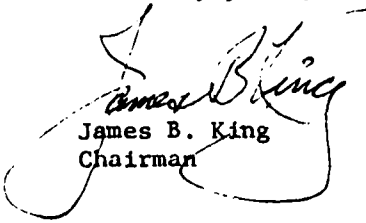
We have noted the reasons given by the FAA for not agreeing to this recommendation, and we have examined Sikorsky S-58 and S-58T service bulletins that recommend visual daily inspection of the tail rotor blade, stipulating that if a crack is suspected, dye penetrant inspections are to be made. However, the same type of service bulletin inspection requirements for the S-58 and S-58T had been issued on the S-61L and were being complied with at the time of the Newark, New Jersey, accident. We contend that a blade skin crack, caused by a crack propagating through the spar cross section, may be difficult to detect visually while conducting the recommended service bulletin inspections. Based on the metallurgical examination of the failed blade, the crack on the skin did not occur until the spar fatigue crack had propagated through a significant portion of the cross section.

Honorable Langhorne M. Bond

- 2 -

Since compliance with the existing tail rotor blade skin inspections are inadequate to detect an unsafe condition in the blade spar, we request the FAA to reconsider this recommendation. Pending the FAA's further response, A-79-85 is being maintained in an "open-unacceptable action" status.

Sincerely yours,



James B. King  
Chairman

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591



OFFICE OF  
THE ADMINISTRATOR

February 15, 1980

Honorable James B. King  
Chairman, National Transportation Safety Board  
800 Independence Ave., S.W.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Recommendation A-79-85 issued by the Board on November 19, 1979, regarding Sikorsky S-58 and S-58T model helicopters. The recommendation resulted from the Board's investigation of a Sikorsky S-61L helicopter crash at Newark International Airport, Newark, New Jersey, on April 18, 1979.

Recommendation A-79-85. Issue an Airworthiness Directive to require a one-time ultrasonic inspection of tail rotor blades installed on S-58 and S-58T model helicopters for evidence of spar cracks and, if necessary, establish a recurring spar inspection based on an appropriate number of operating hours.

Comment. We do not concur with this recommendation for the following reasons:

1. We do not believe that an Airworthiness Directive should be issued based on similarity of design because the loads and stresses imposed on the S-58 tail rotor blades are less than those for the S-61 helicopter.
2. Service difficulty reports on the S-58 tail rotor blades do not indicate that an unsafe condition exists. The only indication of a possible fatigue failure of a tail rotor blade that we have received was based upon the outboard section of a blade found in the sea after the helicopter had capsized. We have no information on the inspection or maintenance of the tail rotor or information on whether or not there was foreign object damage of the blade. This report is the only indication of a possible fatigue failure of the spar in over 20 years of service.

AD-A118 692

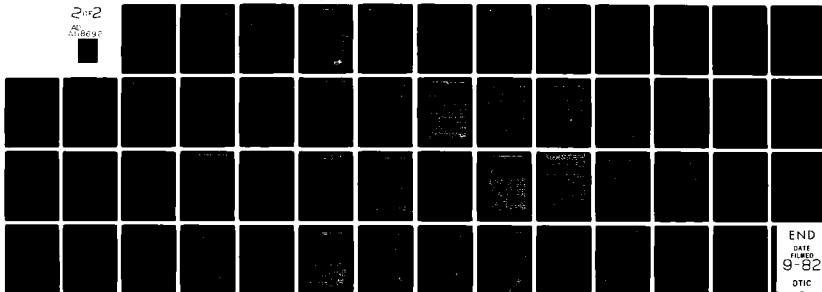
FEDERAL AVIATION ADMINISTRATION WASHINGTON DC OFFICE--ETC F/6 5/4  
SUMMARY OF FEDERAL AVIATION ADMINISTRATION RESPONSES TO NATIONAL--ETC(U)  
JAN 82 J H MACKINNON; C A CARPENTER  
FAA-ASF-300-82-2

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AD-A118 692

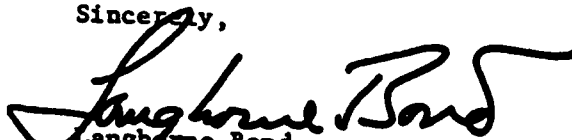


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3. Tail rotor blades, because they are likely to be struck by debris thrown up by the main rotor air flow and because they are turning rapidly, are subject to foreign object damage. Sikorsky has issued service bulletins to specify and to emphasize daily visual and, if a crack is suspected, dye penetrant inspections of the S-58 tail rotor blades.

Sincerely,

  
Langhorne Bond  
Administrator

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591



OFFICE OF  
THE ADMINISTRATOR

February 15, 1980

Honorable James B. King  
Chairman, National Transportation Safety Board  
800 Independence Ave., S.W.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Recommendation A-79-85 issued by the Board on November 19, 1979, regarding Sikorsky S-58 and S-58T model helicopters. The recommendation resulted from the Board's investigation of a Sikorsky S-61L helicopter crash at Newark International Airport, Newark, New Jersey, on April 18, 1979.

Recommendation A-79-85. Issue an Airworthiness Directive to require a one-time ultrasonic inspection of tail rotor blades installed on S-58 and S-58T model helicopters for evidence of spar cracks and, if necessary, establish a recurring spar inspection based on an appropriate number of operating hours.

Comment. We do not concur with this recommendation for the following reasons:

1. We do not believe that an Airworthiness Directive should be issued based on similarity of design because the loads and stresses imposed on the S-58 tail rotor blades are less than those for the S-61 helicopter.
2. Service difficulty reports on the S-58 tail rotor blades do not indicate that an unsafe condition exists. The only indication of a possible fatigue failure of a tail rotor blade that we have received was based upon the outboard section of a blade found in the sea after the helicopter had capsized. We have no information on the inspection or maintenance of the tail rotor or information on whether or not there was foreign object damage of the blade. This report is the only indication of a possible fatigue failure of the spar in over 20 years of service.

2

3. Tail rotor blades, because they are likely to be struck by debris thrown up by the main rotor air flow and because they are turning rapidly, are subject to foreign object damage. Sikorsky has issued service bulletins to specify and to emphasize daily visual and, if a crack is suspected, dye penetrant inspections of the S-58 tail rotor blades.

Sincerely,

A handwritten signature in dark ink, appearing to read "Langherne Bond". The signature is fluid and cursive, with a large initial "L" and a long, sweeping underline.

Langherne Bond  
Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: November 19, 1979

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Forwarded to:

Honorable Langhorne M. Bond  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-79-85

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On April 18, 1979, a Sikorsky S-61L helicopter crashed at Newark International Airport, Newark, New Jersey. The Safety Board determined that the probable cause of the accident was the separation of the tail rotor assembly and gearbox from the aircraft at an altitude which made further controlled flight impossible. The rotor assembly and gearbox separated because of severe vibrations in the rotor assembly which were induced by the loss of a tail rotor blade due to fatigue failure. Metallurgical examination of the blade's spar revealed a fatigue fracture across 90 percent of its cross section 35 inches from the outboard end. The blade is designed and manufactured so that the spar is completely enclosed in an aluminum skin envelope, thereby making visual inspection of the spar impossible.

The Sikorsky S-58 model helicopter uses a tail rotor blade identical in design to the S-61L model blade, although dimensionally it is smaller in the spanwise direction. The Board learned that one tail blade spar failure has occurred recently on an S-58T model helicopter in South America. Loss of a section of blade on the S-58 results in the same conditions that occurred on the S-61L at Newark, New Jersey.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Airworthiness Directive to require a one-time ultrasonic inspection of tail rotor blades installed on S-58 and S-58T model helicopters for evidence of spar cracks and, if necessary, establish a recurring spar inspection based on an appropriate number of operating hours.  
(Class I, Urgent Action) (A-79-85)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By James B. King  
Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

February 23, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendations A-81-83 and A-81-84 issued by the Board on August 3, 1981, and supplements our letter of October 8, 1981. This also responds to your letter of December 15, 1981, in which you advised Recommendations A-81-83 and A-81-84 have been classified in an "Open—Acceptable Alternate Action" status pending the Federal Aviation Administration's (FAA) final response of completed action. These recommendations resulted from your investigation of an accident involving a Beechcraft Model B19 aircraft that crashed shortly after takeoff from Kinston Jet Port, Kinston, North Carolina, on June 23, 1980. Investigation revealed that the left aileron push-pull rod end had failed resulting in a loss of lateral control.

A-81-83. Require that the actions outlined in Beechcraft Class II Service Instruction No. 0858-151 as revised be completed on the affected aircraft at the next 100-hour or annual inspection.

A-81-84. Require installation of access plates on all Beechcraft Models B19, 23, 24, and 24R series aircraft manufactured before 1977 to provide access to the aileron push-pull rods, bellcrank, and cable attachments for inspection or servicing.

FAA Comment. As noted in our letter of October 8, 1981, the FAA will issue an airworthiness alert in the April 1982 publication of the General Aviation Airworthiness Alert (AC-43-16). An advance copy of the text is enclosed. This publication is designed to identify and to emphasize significant maintenance items. It is the most appropriate way to ensure efficiency of future inspection and servicing of the aileron push-pull rod, bellcrank and cable attachments. This airworthiness alert also provides installation instructions to install access inspection plates to pre-1977 Beechcraft Models 19, 23, 24, and 24R series aircraft.

We believe this action satisfies the intent of Safety Recommendations A-81-83 and A-81-84. Accordingly, FAA considers action completed on these recommendations.

Sincerely,



J. Lynn Helms  
Administrator

Enclosure



# National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

December 15, 1981

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

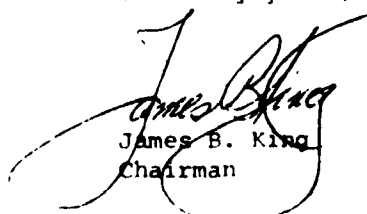
Dear Mr. Helms:

Reference is made to the Federal Aviation Administration (FAA) letter of October 8, 1981, responding to National Transportation Safety Board Safety Recommendations A-81-83 and -84 issued August 3, 1981. These recommendations stemmed from our investigation of an accident involving a Beechcraft Model B19 that crashed shortly after takeoff from Kinston Jet Port, Kinston, North Carolina, on June 23, 1980. Investigation revealed that the left aileron push-pull rod end had failed resulting in a loss of lateral control.

We agree with the FAA that the failure was the result of poor maintenance and that measures to emphasize the importance of the prescribed maintenance should prevent accidents and incidents of this nature. However, we do not agree with the observation that the problem cannot lead to fatal accidents. On April 30, 1967, a Beech 23, N8728M, made an uncontrolled descent and crashed at Naushan Islands, Massachusetts. There were four fatalities. The probable cause of the accident was attributed to the failure of an aileron and aileron tab control system. On June 7, 1975, at Baldwin, Wisconsin, a Beech 23, N4769J, crashed after takeoff when the left aileron push rod end separated. The rod end had frozen on the ball insert due to rust and corrosion. There was one serious injury. We, therefore, believe that problems with aileron push-pull rod end bearings, leading to loss of lateral control, do have the potential for fatal accidents. Our records indicate that since the October 1980 airworthiness alert there have been two cases of rod end failure--one on December 12, 1980, and the other on September 15, 1981.

We note that the FAA considers an FAA airworthiness alert the appropriate method to provide information to repair stations and maintenance personnel. We are also informed that the FAA is working with the manufacturer to develop a new airworthiness alert item which will provide the installation instructions required to add access doors to pre-1977 Models 19, 23, 24, and 24R aircraft. The Safety Board considers this action by the FAA to satisfy the intent of both Safety Recommendations A-81-83 and -84 which we have classified in an "Open--Acceptable Alternate Action" status pending the FAA's final response of completed action.

Sincerely yours,

  
James B. King  
Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. S.W.  
Washington, D.C. 20591

October 8, 1981

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendations A-81-83 and A-81-84 issued by the Board on August 3, 1981. These recommendations resulted from the Board's investigation of the crash of a Beechcraft Model B19, N60BW, after takeoff from Kinston, North Carolina, on June 23, 1980. The pilot stated that he was unable to maintain lateral control.

A-81-83. Require that the actions outlined in Beechcraft Class II Service Instruction No. 0858-151 as revised be completed on the affected aircraft at the next 100-hour or annual inspection.

FAA Comment. The FAA does not concur in this recommendation. Although lateral control is affected by rod end/bearing failures, this type of failure does not comprise the total set of lateral control related accidents cited in the safety recommendation data. Only two of the six accidents cited were related to rod end/bearing failures, and we are not aware of any fatalities which have occurred as a result of rod end/bearing failures.

Most rod end/bearing failures are related to inattentive maintenance over an extended period of time. An FAA airworthiness directive (AD) to require rod end inspections and replacement in accordance with Beechcraft Class II Service Instruction No. 0858-151 procedures is not warranted since we have no evidence to indicate that operators are choosing to ignore the maintenance procedures recommended by the manufacturer. In our judgment, there is adequate maintenance information available to maintain the rod ends and maintenance personnel typically conduct required inspections in an acceptable manner. This position is in concert with Amendment 3 to Part 21 and Amendment 106 to Part 39 which, in part, state, "The Agency, accordingly, will not issue ADs as a substitute for enforcing maintenance rules."

The General Aviation Airworthiness Alert system is designed to identify and to emphasize maintenance significant items like the one identified in the NTSB investigation preceding Recommendation A-81-83. This is the most appropriate

way to ensure efficiency of future maintenance of the aileron rod ends. As noted in the text of the safety recommendation letter, this area was the subject of an October 1980 airworthiness alert to authorized inspectors and repair stations reinforcing the importance of inspection and lubrication of rod ends in accordance with recommended maintenance procedures. There have been no further service difficulty reports since the October 1980 alert. We will continue to monitor service difficulty reports for this condition, but in the absence of documented failure, we do not plan to pursue this matter further and consider action completed on Safety Recommendation A-81-83.

A-81-84. Require installation of access plates on all Beechcraft Models B19, 23, 24, and 24R series aircraft manufactured before 1977 to provide access to the aileron push-pull rods, bellcrank, and cable attachments for inspection or servicing.

FAA Comment. Access doors that provide an alternate means of lubrication and inspection of rod end bearings would facilitate maintenance of the pre-1977 aircraft noted in this safety recommendation. However, we do not concur in the requirement for mandatory installation of such access doors by AD action. As stated in our response to Recommendation A-81-83, adequate maintenance information and access are available, and the vast majority of maintenance personnel are conducting required inspections in an acceptable manner.

An FAA Airworthiness Alert is the appropriate method to provide this information to repair stations and maintenance personnel. We are presently working with the manufacturer to develop a new airworthiness alert item which will provide the installation instructions required to add such access doors to pre-1977 Models 19, 23, 24, and 24R aircraft. With the issuance of this alert, the FAA considers action on Safety Recommendation A-81-84 completed.

Sincerely,

  
J. Lynn Helms  
Administrator

# NATIONAL TRANSPORTATION SAFETY BOARD

## WASHINGTON, D.C.

ISSUED: August 3, 1981

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-83 and -84

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On June 23, 1980, a Beechcraft Model B19, N60BW, crashed shortly after takeoff from Kinston Jet Port, Kinston, North Carolina. The pilot, who received minor injuries, stated that he was not able to maintain lateral control.

The investigation revealed that the left aileron push-pull rod end, which is connected to the aileron bellcrank inside the wing, had failed. The left aileron push-pull rod was examined by an independent engineering testing company, which reported that: (1) the push-pull rod failure was caused by fatigue in reverse bending, (2) the reverse bending force was apparently transmitted from a seized bearing connection to the minimum cross-section of the rod at the root of the machined threads, and (3) the bearing connection at the failed end of the rod was seized because of inadequate bearing lubrication and the subsequent formation of corrosion products which prevented rotational and lateral movement in the bearing connection.

The aircraft records indicated that the last annual inspection was completed on August 20, 1979, 130 tachometer hours before the accident. However, the Safety Board could not determine whether the rod end bearings were lubricated during the inspection. The Beechcraft lubrication diagram in the maintenance manual recommends that the ends of the aileron push-pull rod be lubricated at every 100-hour inspection.

On July 8, 1975, Beechcraft issued a Safety Communique to all owners of Beechcraft Models B19, 23, 24, and 24R series aircraft. The communique indicated that some flight control system pivots and moving parts subject to wear may not have been lubricated adequately, and urged that the flight controls be checked for freedom of movement during each walk-around inspection and before each flight. It further recommended that the controls be serviced and lubricated at proper intervals to insure proper functioning of the flight controls.

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In August 1975, Beechcraft issued Class II Service Instruction No. 0760-010, which pertained to specific Beechcraft Models B19, 23, 24, and 24R series aircraft. Service Instruction No. 0760-010 recommended, during normal maintenance, a general inspection or replacement, or both, of rod end bearings used on engine controls, landing gear retraction systems, nose landing gear steering mechanisms, and flap, aileron, elevator, rudder, and tab controls. The purpose of the service instruction, in part, was to advise all owners that, on occasion, some rod end bearings manufactured by Nippon Miniature Bearing Corporation had seized in service and that, at the owner's discretion, the rod end bearings should be replaced by corresponding parts manufactured by other vendors.

In August 1976, Beechcraft issued Class II Service Instruction No. 0858-151, which pertained to specific Beechcraft Models B19, 23, 24, and 24R series aircraft. The purpose of Service Instruction No. 0858-151 was to insure freedom of movement and proper functioning of all flight control rod ends and pivotal points. In part, the service instruction referred specifically to the aileron push-pull rod ends, indicated that restricted movement of the rod end indicates corrosion in the rod end, and further stated that if corrosion is noted both existing forward and aft rod ends should be replaced with new rod ends (P/N 169-380082-3).

The Safety Board could not determine if the aileron rod ends on N60BW were inspected in accordance with the Beechcraft Class II service instructions. However, examination of the failed forward aileron push-pull rod end indicated that the failed rod end (PN HM-4U-M) was manufactured by Heim Company. The aft push-pull rod end (PN HM-4, NMB) which did not fail was manufactured by Nippon Miniature Bearing Corporation. However, this push-pull rod end bearing did not rotate freely in all directions. Based on the identification of the failed push-pull rod end, the forward rod end was installed in accordance with Beechcraft Class II Service Instruction No. 0760-010, but the aft rod end was not replaced as recommended in that service instruction.

The Safety Board's aircraft accident data indicate that between 1964 and 1979 six accidents have involved Beechcraft Models B19, 23, and 24R aircraft in which lateral control was found to be a cause or factor. These accidents resulted in five fatal injuries, two serious injuries, and minor or no injuries to five persons. One accident resulted from frozen rod end bearings and another resulted from a failed rod end. The remaining four accidents resulted from improper installation of the aileron after maintenance.

A review of the Federal Aviation Administration's Service Difficulty Records from January 1976 through January 8, 1981, revealed 15 occurrences of problems with aileron push-pull rod end bearings on Beechcraft Models B19, 23, 24, and 24R series aircraft. Fourteen were related to seized or broken rod ends. Based on the continuing reports of similar failures, the FAA published this information in its General Aviation Alert, Advisory Circular 43-16, dated October 1980.

On earlier models of Beechcraft B19, 23, 24, and 24R series aircraft, such as N60BW, the forward aileron push-pull rod end bearings, aileron bellcrank pivotal point, and cable attachments are relatively inaccessible for routine inspections and maintenance because panels were not installed in the wings for inspection purposes. The ailerons and guard strap from the closure strip must be removed to perform an inspection or routine maintenance. To improve access to those push-pull rod ends, an aircraft and powerplants mechanic employed by a Kinston facility, on his own initiative, installed inspection access panels using approved inspection plates and doublers on a similar aircraft. The mechanic was later nominated for a General Aviation Mechanics Safety Award.

Since 1977, Beechcraft has incorporated aileron access panels in the wings on its Models B19, 23, and 24 series aircraft. The wing access panels provide an opening through which mechanics can inspect and service the forward aileron push-pull rod end bearings without removing the ailerons--thus reducing the man-hours required for inspection and maintenance and eliminating the need to remove the ailerons. The Safety Board believes that the installation of these panels in aircraft manufactured before 1977 would improve the maintainability of these aircraft by making it easier for mechanics to inspect and lubricate the rod end fittings without having to remove the ailerons. This would also reduce the possibility of an improper installation of the aileron by reducing the number of times they must be removed and reinstalled.

In view of the continuing reports on this problem and the hazards associated with a loss of aileron control, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that the actions outlined in Beechcraft Class II Service Instruction No. 0858-151 as revised be completed on the affected aircraft at the next 100-hour or annual inspection. (Class II, Priority Action) (A-81-83)

Require installation of access plates on all Beechcraft Models B19, 23, 24, and 24R series aircraft manufactured before 1977 to provide access to the aileron push-pull rods, bellcrank, and cable attachments for inspection or servicing. (Class II, Priority Action) (A-81-84)

KING, Chairman, DRIVER, Vice Chairman, McADAMS and GOLDMAN, Members, concurred in these recommendations. BURSLEY, Member, did not participate.

  
By: James B. King  
Chairman



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave., S.W.  
Washington, D.C. 20591

March 5, 1982

Mr. Jim Burnett  
Acting Chairman, National Transportation  
Safety Board  
800 Independence Avenue SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in further response to NTSB Safety Recommendation A-81-74 issued by the Board on July 28, 1981, and supplements our letter of October 27, 1981. This also responds to your letter of December 15, 1981, in which it was stated that this recommendation is held in an "Open—Acceptable Alternate Action" status. This recommendation resulted from the Board's investigation of the crash of Cascade Airways Inc., Flight 201, a Beech 99A near Spokane, Washington, on January 20, 1981.

A-81-74. Require in future radio navigation instrument installations, that all frequencies being received through navigational receivers that are providing essential navigational information (directional guidance or distance) be displayed so that the source of the navigational signal can be readily discerned by the pilot.

FAA Comment. In our letter of October 27, 1981, we stated that the Federal Aviation Administration (FAA) planned to review the feasibility of including a new requirement in future radio navigational instrument design criteria which would insure that all frequencies or station identifiers providing essential navigational information (directional guidance or distance) be displayed in such a way that the source of the navigational signal can be readily discerned by the pilot. We have completed our aircraft systems review to require the source/identification of the navigational frequencies used by the pilot. Accordingly, a meeting of the Radio Technical Commission for Aeronautics (RTCA) ad hoc committee for review of navigation documents was held in November and the FAA proposed the inclusion of "requirement of source identification of the navigational frequencies used by the pilot" in the terms of reference for the Minimum Operational Performance Standards (MOPS) on their very high frequency omnirange (VOR) and distance measuring equipment (DME) documents. The MOPS serves as the source reference document for the VOR and DME FAA Technical Standards Orders (TSO).

The FAA believes that the intent of Recommendation A-81-74 will be met by inclusion of this requirement in all MOPS for TSO updates to navigational equipment. This action would then satisfy the intent of this recommendation and we consider it closed.

Sincerely,

  
J. Lynn Helms  
Administrator



# National Transportation Safety Board

Washington, D.C. 20594

December 15, 1981

Office of the Chairman

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

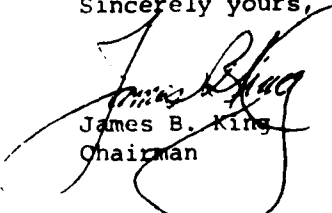
Dear Mr. Helms:

Thank you for your letter dated October 27, 1981, responding to National Transportation Safety Board Safety Recommendation A-81-74 issued July 28, 1981. This recommendation stemmed from our investigation of a Cascade Airways, Inc., Beech 99A accident near Spokane, Washington, on January 20, 1981. The aircraft crashed about 4.5 miles southwest of Spokane International Airport while the pilot was making an instrument landing system approach in instrument meteorological conditions. We concluded that the crew probably used the distance measuring equipment (DME) from the Spokane VORTAC (located 4.2 miles from the end of the runway) rather than the DME associated with the localizer (located at the end of the runway). We recommended that the Federal Aviation Administration (FAA):

Require in future radio navigation instrument installations, that all frequencies being received through navigational receivers that are providing essential navigational information (directional guidance or distance) be displayed so that the source of the navigational signal can be readily discerned by the pilot.

We note that the FAA plans to review the feasibility of including a new requirement in future radio navigation instrument design criteria. This will insure that all frequencies or station identifiers providing essential navigational information (directional guidance or distance) are displayed in a manner so that the source of the navigational signal is readily discernible by the pilot. Pending the FAA's further response, this recommendation is held in an "Open--Acceptable Alternate Action" status.

Sincerely yours,

  
James B. King  
Chairman



US Department  
of Transportation  
**Federal Aviation  
Administration**

Office of the Administrator

800 Independence Ave. SW  
Washington, D.C. 20591

OCT 27 1981

The Honorable James B. King  
Chairman, National Transportation  
Safety Board  
800 Independence Avenue, SW.  
Washington, D.C. 20594

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-81-74 issued by the Board on July 28, 1981. This recommendation resulted from the Board's investigation of the crash of Cascade Airways, Inc., Flight 201, a Beech 99A near Spokane, Washington, on January 20, 1981.

Investigation of the accident revealed that Flight 201, operating on an instrument flight rules (IFR) flight plan in instrument meteorological conditions, was initially vectored for an instrument landing system (ILS) approach to runway 21 after contacting Spokane approach control. When the active runway was later changed to runway 3, Flight 201 was vectored to the final approach course even though activation of the localizer for runway 3 was delayed to allow another aircraft to complete its ILS approach and landing on runway 21. When the localizer for runway 3 was activated, Flight 201 was advised promptly and given the aircraft's position as 6 miles from the OLAKE intersection.


Based on an analysis of the investigative evidence and the operation and display of the distance measuring equipment (DME) mode selector installed in the accident aircraft, the Safety Board concluded that the crew probably used the DME from the Spokane VORTAC (located 4.2 miles from the end of the runway) rather than the DME associated with the localizer (located at the end of the runway).

A-81-74. Require in future radio navigation instrument installations, that all frequencies being received through navigational receivers that are providing essential navigational information (directional guidance or distance) be displayed so that the source of the navigational signal can be readily discerned by the pilot.

FAA Comment. The Federal Aviation Administration (FAA) concurs in the intent of Recommendation A-81-74. However, we plan no regulatory amendments relative to this recommendation because current regulations, specifically Sections 23.1301, 25.1301, 27.1301, and 29.1301, are considered adequate for implementation of the requirements defined in the recommendation.

In order to satisfy the intent of this recommendation, we plan to review the feasibility of including a new requirement in future radio navigation instrument design criteria. This addition would insure that all frequencies or station identifiers providing essential navigational information (directional guidance or distance) be displayed in such a way that the source of the navigational signal can be readily discerned by the pilot. If the results of our feasibility review indicate a need for new requirements in future design criteria, the FAA will then issue guidance material and pursue further appropriate action. The Board will be informed of the results of our efforts in this area.

Sincerely,



J. Lynn Helms  
Administrator

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: July 28, 1981

Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

**SAFETY RECOMMENDATION(S)**

**A-81-74**

On January 20, 1981, Cascade Airways, Inc., Flight 201, a Beech 99A, crashed about 4.5 miles southwest of Spokane International Airport, Spokane, Washington. The flight was operating as a scheduled commuter under 14 CFR Part 135.

The National Transportation Safety Board's investigation of the accident revealed that Flight 201, operating on an instrument flight rules (IFR) flight plan in instrument meteorological conditions, was initially vectored for an instrument landing system (ILS) approach to runway 21 after contacting Spokane approach control. When the active runway was later changed to runway 3, Flight 201 was vectored to the final approach course even though activation of the localizer for runway 3 was held up to allow another aircraft to complete its ILS approach and landing on runway 21. When the localizer for runway 3 was activated, Flight 201 was advised promptly and given the aircraft's position as 6 miles from the OLAKE intersection.

Based on an analysis of the investigative evidence and the operation and display of the distance measuring equipment (DME) mode selector installed in the accident aircraft, the Safety Board concluded that the crew probably used the DME from the Spokane VORTAC (located 4.2 miles from the end of the runway) rather than the DME associated with the localizer (located at the end of the runway).

Cascade 201 was equipped with a DME-select switch which had four positions labeled "DME 1", "DME hold", "DME 2", and "RNAV." This feature allows the pilot to do the following: with the "DME 1" button depressed, the DME is automatically tuned to the same frequency as the No. 1 navigation radio. If the pilot then pushes the "DME hold" button and retunes the No. 1 navigation radio, the DME remains on the frequency previously selected on the No. 1 navigation radio. As a result, the DME mileage is generated from a frequency which is not displayed anywhere in the cockpit. The pilot must remember the navigation aid from which the distance information is derived. The Safety Board believes that the captain of Cascade 201 probably used the airborne DME equipment in the manner just described and forgot that the DME equipment was actually tuned to the DME associated with the Spokane VORTAC when the localizer was activated by the tower. The Safety Board believes that a direct readout of the actual frequency being used for navigation should be visually available to the flightcrew at all times.

Although an amber light is activated on the DME mode selector when the "DME hold" function is in use, the light may be overlooked by the pilot in certain situations. While the "DME hold" feature provides the pilot with more flexibility by allowing him to preselect navigation frequencies, this advantage may be offset by the need to remember the source of the DME mileage display during periods of increased cockpit workload.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require in future radio navigation instrument installations, that all frequencies being received through navigational receivers that are providing essential navigational information (directional guidance or distance) be displayed so that the source of the navigational signal can be readily discerned by the pilot. (Class II, Priority Action) (A-81-74)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in this recommendation.

  
By: James B. King  
Chairman

# NATIONAL TRANSPORTATION SAFETY BOARD WASHINGTON, D.C.

ISSUED: January 12, 1962

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-187 through -188

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About 1328 e.d.t., on August 14, 1960, a Piper Model PA-30, twin Comanche N7094Y, crashed in visual meteorological conditions at Cutchogue, New York, shortly after the pilot had executed a missed approach to Mattituck Airport, Mattituck, New York. The pilot was killed. There was no postcrash fire.

A witness to the accident stated that he heard a power reduction and saw the aircraft roll left and spin to the ground. The first person to reach the scene reported that there was no gasoline on the ground nor was there any odor of gasoline.

Shortly before departing Lake Placid Airport, Lake Placid, New York, at 1147 the pilot had refueled the aircraft. The flight to Mattituck was in accordance with an instrument flight rules clearance with an estimated time en route of 1 hour, 40 minutes. The pilot's flight plan indicated that 5 hours' fuel was aboard the aircraft. According to the operator of the Lake Placid Airport, the purpose of the flight was to have engine maintenance performed at Mattituck; the pilot had complained that one engine was using almost "twice as much fuel as normal."

During the investigation, inspections and tests were conducted by the Safety Board at Mattituck Airbase Incorporated. Examination of the wing bladder fuel cells revealed that three of the four fuel cells had been destroyed. The only fuel found, about 4 gallons, was stored in the right main (inboard) fuel cell.

Both aircraft engines were inspected and tested and operated normally. However, the left and right fuel selector valves including the filter, bowl, and drain valve assemblies were contaminated with water-gel particulate, fine reddish brown material in suspension, and other solid particles and foreign material, much of which appeared to be microbial growth.

During functional tests of the fuel selector valves, contamination caused the left fuel selector drain valve to remain in an open or drain position when the drain handle was released—a condition that results in continuous fuel leakage from the drain located beneath the fuselage. Since the spring force acting on the drain plunger valve is relatively light, the drain valve would not return to the spring-loaded, normally closed position until physical pressure was applied to the drain handle. A stiffer spring probably would have resulted in positive closure under the same conditions.

The drain spring retaining washer in the right drain valve assembly was corroded extensively. Although the right fuel drain system was functional, loss of this retaining washer was imminent. Under the circumstances, there would have been no spring force available to hold the drain valve in the closed position and excessive fuel leakage would have occurred.

In Piper Service Spares Letter No. SP-282, issued in 1968, the Piper Aircraft Corporation announced the availability of an improved-design fuel selector valve housing for PA-30 aircraft to improve drainage of moisture and sediment from the fuel system. In Service Letter No. 589, issued in 1971, Piper reiterated the availability of this product improvement because only about 25 percent of PA-30 owners had responded to the aforementioned Service Spares Letter.

Fuel contamination may adversely affect not only fuel system drains but fuel valve porting functions as well. In fuel selectors which incorporate ball check valves, such as those in N7094Y and Piper Models PA-24-400 and PA-39, contaminants may lodge between the ball check valve and valve seat, resulting in a leaking intake port (interport leakage). This condition may cause an unwanted transfer of fuel between tanks and depletion of the available fuel supply.

The Federal Aviation Administration (FAA) issued Airworthiness Directive 79-12-08, applicable to Piper Models PA-24-400, PA-30, and PA-39, in June 1979, to instruct operators on how to detect interport leakage. The fuel selector valves in N7094Y had been tested in compliance with the directive 4 months before the accident at the last annual inspection and they were inspected following the accident, as part of the postcrash investigation. No leakage was found during either inspection. The Safety Board believes, however, that such leakage may occur sporadically and that an absence of interport leakage at any given time is not necessarily an indication of a lack of contamination or that such interport leakage is not imminent. To prevent interport leakage caused by contamination, the entire fuel system should be flushed and cleaned whenever direct inspection discloses evidence of significant contamination.

Between 1975 and 1979, the Piper PA-30 was involved in 20 engine failure/malfunction accidents. Faulty fuel selector valves caused two of the accidents, while three of the accidents were caused by undetermined reasons. Comments taken from small aircraft malfunction/defect report data from the FAA's Maintenance Analysis Center reflect conditions similar to those referred to above or found in the fuel selector valves of N7094Y. For example: "tube in lower section of fuel selector valve corroded; foreign material found under auxiliary tank ball check valve; failure of the retainer would allow the fuel load to drain overboard; fuel valve leaking internally, probable cause—valve stuck in open position; and excessive rust and water in fuel selector drains causing damage to seats and leaking."

In 1971, the Piper Aircraft Corporation issued an airplane flight manual supplement regarding fuel system preflight procedures applicable to Models PA-28-235, PA-32-260, PA-32-300, and PA-32S-300. The supplement contained details directing the pilot's attention to quantity of drainage necessary, examination of drainage for water and sediment, and instructions for assuring that the quick drain was completely closed and not leaking. The Safety Board believes that a similar flight manual supplement is necessary for Models PA-24-400, PA-30, and PA-39.

FAA eastern region personnel assisted in the investigation of the August 14, 1980, accident and later participated in discussions with Safety Board staff regarding necessary remedial actions. We are aware that the FAA Flight Standards Division has recently advised the Piper Aircraft Corporation of its intent to take appropriate corrective action.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Airworthiness Directive requiring an inspection of the fuel selector drain valves installed on Piper Models PA-24-400, PA-30, and PA-39 aircraft for evidence of contamination, and instruct operators to flush fuel tanks and selector valves and clean filter assemblies if contamination is found. (Class II, Priority Action) (A-81-157)

Issue an Airworthiness Directive requiring installation of improved-design fuel drain bowls on Piper Model PA-30 aircraft in accordance with Piper Service Letter No. 589. (Class II, Priority Action) (A-81-158)

Issue an Airworthiness Directive requiring installation of stiffer drain valve plunger springs on Piper Models PA-24-400, PA-30, and PA-39 aircraft so that degradation of positive closure of the valve due to the effects of corrosion and contamination is less likely. (Class II, Priority Action) (A-81-159)

Issue a supplement to the aircraft flight manuals applicable to Piper Models PA-24-400, PA-30, and PA-39, outlining the fuel drainage procedures necessary to avoid the accumulation of water or sediment. (Class II, Priority Action) (A-81-160)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: James B. King  
Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: January 5, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-161

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On July 2, 1981, a Beech aircraft model 65-A80-8800, N100UV, was involved in a fatal accident about 7 miles east-southeast of Madisonville, Texas. The National Transportation Safety Board's investigation has revealed a maintenance problem which we believe warrants attention.

The aircraft was equipped with two Avco Lycoming direct drive engines, Model IO 720-A1B. Disassembly and examination of these engines revealed that a majority of the cylinder base nuts on the right engine, S/N 2-949-54A, were under-torqued. Further examination disclosed that the cylinder boss area under the nuts had been painted. The overhaul manual, section 3, paragraph 3-28, for these engines specifies that "all machined bosses should be masked before painting. Do not paint areas under hold down nuts where torque is required."

Although the under-torqued condition of the engine cylinder base nuts was not considered a factor in this accident, the loss of a cylinder because of this condition could result in a potentially hazardous situation.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue a General Aviation Airworthiness Alert (Advisory Circular 43-16) to emphasize the importance of following the established procedures published in the manufacturer's engine overhaul manual with regard to masking machined bosses when crankcase areas are painted. (Class II, Priority Action) (A-81-161)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS and BURSLEY, Members, concurred in this recommendation. GOLDMAN, Member, did not participate.

  
By: James B. King  
Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: January 5, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-162

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About 1230 e.d.t. on July 2, 1981, a Beech aircraft model 65-A80-8888, N100UV, operated by Universal Airways, Inc., under 14 CFR 91, crashed about 7 miles east-southeast of Madisonville, Texas. Witnesses heard a small explosion and saw the aircraft descend from a dark cloud; the wings and the empennage were not attached during the observed portion of the aircraft's descent. The pilot and both passengers were killed. The aircraft was destroyed. 1/

The investigation indicates that the in-flight breakup was probably caused by excessive airloads generated by a nose up control input by the pilot at high speed. Based on weather observations made by the National Weather Service, reports from pilots in the Madisonville area, and observations of witnesses to the accident, the in-flight breakup may have occurred in light-to-moderate turbulence in instrument meteorological conditions.

A review of the pilot's records indicated that he had limited experience in the operation of multiengine aircraft in instrument meteorological conditions and had not received instrument training in a multiengine aircraft. Because the pilot had acquired an instrument rating in a single-engine aircraft, he had not been required to demonstrate to a flight instructor or flight examiner his ability to satisfactorily cope with in-flight emergencies, such as unusual attitudes, gyro instrument failure, or engine failure, in a multiengine aircraft under simulated or actual instrument meteorological conditions.

1/ For more detailed information, read Aircraft Accident Report - "Universal Airways, Inc., 65-A80/Excalibur Conversion, N100UV, Near Madisonville, Texas, July 2, 1981" (NTSB-AAR-81-17).

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While there is a commonality between single-engine and multiengine instrument flying techniques and procedures, multiengine aircraft require a greater degree of piloting skill because of the additional powerplants, more complex systems, and larger sizes and weights. The Safety Board believes that the differences in the flight characteristics and emergency procedures between single-engine and multiengine rating aircraft are such that flight instructors/examiners should require multiengine applicants who received their instrument rating in a single-engine aircraft to satisfactorily demonstrate their ability to handle abnormal in-flight situations in a multiengine aircraft under actual or simulated instrument meteorological conditions.

Accordingly, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require all holders of an instrument rating and a multiengine rating to demonstrate their ability to operate a multiengine aircraft under normal and emergency conditions by reference to flight instruments only as a prerequisite to exercising the privileges of an instrument rating in multiengine aircraft. (Class II, Priority Action) (A-81-162)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS and BURSLEY, Members, concurred in this recommendation. GOLDMAN, Member, did not participate.

  
By: James B. King  
Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: January 25, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-163 through -169

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On April 17, 1981, Air U.S. 716, HP-137 (Jetstream), and Sky's West Parachute Center's Cessna TU-206 collided in midair at 13,000 feet m.s.l. near the Ft. Collins/Loveland Airport, Loveland, Colorado. 1/ The midair collision illustrates certain Safety Board concerns related to air traffic control procedures and existing regulations with respect to parachute jump operations.

FAA Regulation 14 CFR 91.24(b)(4) prohibits flight above 12,500 feet without a Mode-C encoding altimeter unless deviation has been authorized by the FAA in accordance with 14 CFR 91.24(c). Sky's West had been conducting parachute jump operations from the Ft. Collins/Loveland Airport since November 1979 at the rate of more than 10,000 jumps per year. The great majority of these operations involved flight above 12,500 feet for jump purposes. None of the Sky's West aircraft was equipped with Mode-C altitude encoding transponders and no continuing waiver had been issued to Sky's West to permit such operations above 12,500 feet without a transponder as required by 14 CFR 91.24. Rather, the Denver Center controllers on a routine basis allowed these flights to operate at altitudes above 12,500 feet. The controllers testified that they believed that they were not granting permission to these flights, but were simply acknowledging advisories that they were, in fact, operating at these altitudes. The Board believes that this routine practice of the Denver Center in not questioning such operations or in any way restricting these aircraft from operating above 12,500 feet without a Mode-C transponder indicated tacit approval. The permissiveness of the Denver Center created a situation wherein Sky's West believed that they had a standing waiver from the regulatory requirements for operations of this type, and it became an acceptable practice not only to Sky's West but also to Denver Center personnel. It is further believed that this permissiveness generated an atmosphere of complacency both at the Center and within the Sky's West operation which led to laxity, even with respect to the existing communications procedures. This was exemplified by the communications between the Sky's West pilot and the Denver Center during the flight about 2 hours before the accident flight, when the pilot advised the Center that he was going to 15,500 feet and the controller simply replied with "roger."

1/ For more detailed information, read Aircraft Accident Report — "Air U.S. Flight 716, HP-137, N11380, and Sky's West Cessna TU-206, N4862F, Midair Collision, Ft. Collins/Loveland Municipal Airport, Loveland, Colorado, April 17, 1981" (NTSB-AAR-81-18).

It should also be noted that the pilot of the Cessna had frequently been assigned code 1-2-3-4 by the controllers for use during parachute jump operations. Consequently, the pilot believed that this was a permanently assigned code and that by merely squawking 1-2-3-4 positive radar identification was provided for the aircraft. This misconception created an unsafe condition in that it provided a false sense of security for the Cessna pilot.

The Safety Board believes that the FAA should prohibit jumping on or within a specified distance from airways or in congested airspace. (This accident occurred about 1 nmi off airways in airspace normally used for aircraft departing Denver's Stapleton International Airport.)

Additionally, the Board believes that FAA should direct their ATC facilities to notify the appropriate General Aviation District Office when any of its control facilities become aware of violations of regulations or safety issues concerning parachute jumping. Had this occurred prior to the accident, a better understanding of their respective responsibilities on the part of the jump school operator and the FAA facilities would have been effected.

In view of the information developed during the investigation of this accident, the Safety Board believes that the United States Parachute Association should immediately make their members aware of this accident and encourage them to communicate on the aircraft radio with the control facility having jurisdiction of the airspace in which the jump is to be initiated. This communication should include a request for VFR traffic advisories as soon as practicable after takeoff and should be done in addition to the 5-minute notification required by 14 CFR 105.14.

The Board also believes that the intent of 14 CFR 105.14 would be better served if 105.14 (a) (1) (ii) were to require that radio communication be established between the jump aircraft and the air traffic control facility having jurisdiction of the airspace in which the jump is to be initiated. The present regulation states the "nearest FAA air traffic control facility or FAA flight service station." It should be noted that the nearest facility may not necessarily be the facility having control jurisdiction over the airspace in which the jump is conducted. Also, according to this regulation in its present form, Sky's West could have contacted a flight service station and satisfied the requirements of the regulation. However, the flight service station would not have been able to provide traffic advisories.

To cover the situation of a jump being initiated in one control facility's airspace and descending into another facility's airspace, the facility contacted should be the air traffic control facility which has jurisdiction of the airspace in which the jump is to be initiated. Air Traffic Control Handbook 7110.65B should then be revised to require that the controller in communication with the jump aircraft, when the jump is initiated, coordinate with the control facility having jurisdiction over the airspace into which jumpers will descend. This would then enable a complete exchange of traffic information between the pilot of the jump aircraft, the jumpers, and all additional potentially conflicting aircraft involved. The Board believes that these changes to 14 CFR 105.14 would enhance aviation safety.

The Board realizes that the primary intent of Part 105 is to provide protection to parachute jumpers from collision with transiting aircraft. However, the circumstances of this accident dramatize the fact that an aircraft in a parachute jumping operation is in effect an "elevator in the sky." It is generally not "straight and level" but is circling in a

climb or descent altitude. This reduces cockpit visibility and makes the sighting of other potentially conflicting traffic more difficult. When we consider the number of times per year such operations occur, the magnitude of the problem becomes quite evident. It is because of this potential that we believe the concept or intent of 14 CFR 105 should be expanded to include an increased level of safety via traffic advisories while a jump aircraft is proceeding to and departing from the location where jumpers are released.

The effectiveness of a pilot's detecting airborne targets depends upon his expectations in finding a target that he has been alerted to, his physical well-being, how he time-shares the instrument scanning and outside scanning, and the techniques used in searching for airborne targets. Obviously, if a pilot assumes that he is protected by ATC and/or is fatigued, bored, preoccupied, or distracted, his ability to scan the airspace while simultaneously watching cockpit displays, flying the aircraft, and monitoring ATC communications will be seriously impaired.

In this accident, there was no evidence to indicate that the Jetstream pilots were fatigued or physically unfit. It is not possible to determine how much time during the final 120 seconds of flight each pilot could have devoted to outside scanning, nor is it known what each pilot's scanning habits or techniques might have been.

A recent NASA study of data from the Aviation Safety Reporting System (ASRS) on near midair collisions indicated that half of 78 near midair collisions in Terminal Controlled Airspace (TCA's) involved one aircraft not known to ATC. "If ASRS reports are representative, many pilots under radar control believe that they will be advised of traffic that represents a potential conflict and behave accordingly. They tend to relax their visual scan for other aircraft until warned of its presence; when warned of a conflicting aircraft, they tend to look for it to the exclusion of within-cockpit tasks and scanning for unreported traffic." The report continues: "The air traffic controller cannot inform the pilot of traffic that is not visible on his radar scope, nor can he provide separation from such traffic. It is plain that at least some pilots receiving Stage III services believe that they will be told about all traffic that represents a threat, yet controllers can handle traffic only with regard to threats they can see . . . ."

The authors of the 1980 NASA study concluded that: "A variety of human and system factors was found to be associated with these near midair collisions. Flightcrew workload, limited visual scan while under radar control, misunderstanding of the limitations of the ATC system, and failure to utilize transponders were observed. A substantial number of reported near midair collisions in Stage III terminal airspace involved at least one aircraft not participating in Stage III services. For these reasons, pilots must exercise the highest level of vigilance for other traffic, regardless of airspace or radar services being utilized." Although the Safety Board could not determine precisely why the Jetstream flightcrew did not see the Cessna 206, these conclusions are applicable to the present accident situation as likely explanations for the failure of the "see and avoid" concept to have prevented this collision. The Safety Board recognizes the inherent limitations of the see and avoid concept and have cited them in numerous Board reports involving midair collisions. Although the FAA has published considerable data regarding the need for continued pilot vigilance in order to minimize the collision hazard, the Board believes that there is still insufficient, detailed information available for the enlightenment of pilots and controllers regarding the limitations associated with this concept. Notwithstanding the above cited limitations, the Safety Board believes that strict adherence by all concerned to existing rules contained in 14 CFR 91 and 105 and applicable procedures set forth in the Airman's Information Manual could possibly have prevented this accident.

As a result of this investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Direct ATC facilities to notify the appropriate General Aviation District Office when any of its control facilities become aware of violations of regulations or safety issues concerning parachute jumping. (Class I, Urgent Action) (A-81-163)

Revise 14 CFR 105.23 to prohibit parachute jump operations in or near Federal airways and determine an acceptable safe distance from such airways at which jump operations can be conducted without conflict with other air traffic. (Class II, Priority Action) (A-81-164)

Establish a special transponder code with an appropriate and readily identifiable radar display for all parachute jump operations. (Class II, Priority Action) (A-81-165)

Revise Advisory Circular 90-48B, "Pilot's Role in Collision Avoidance" to include detailed information regarding the psychophysiological factors affecting pilots' ability to see and avoid other aircraft. (Class II, Priority Action) (A-81-166)

Amend 14 CFR 105.14 to require that a parachute jump aircraft contact the air traffic control facility having jurisdiction of the airspace in which the jump is to be initiated rather than the "nearest FAA air traffic control facility or FAA flight service station." (Class II, Priority Action) (A-81-167)

Amend 14 CFR 105 to require that the pilot of a jump aircraft contact all control facilities having jurisdiction of the airspace in which the aircraft will transit during the operation for the purpose of receiving traffic advisories while proceeding to and departing from the location where jumpers are released. This should be in addition to the requirement of 104.14 (a) (1) (ii) for a 5-minute notification before jump operations are begun. (Class II, Priority Action) (A-81-168)

Amend Air Traffic Control Handbook 7110.65B to require a controller who receives a notification from a jump aircraft, required by 14 CFR 105.14, that the jumpers will descend into another facility's airspace coordinate with that facility so that a complete exchange of traffic can be effected between the jump aircraft, the jumpers, and all potentially conflicting aircraft involved. (Class II, Priority Action) (A-81-169)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, and BURSLEY, Members, concurred in these recommendations. GOLDMAN, Member, did not participate.

*Jim Burnett for*  
By: James B. King  
Chairman

# NATIONAL TRANSPORTATION SAFETY BOARD

## WASHINGTON, D.C.

ISSUED: January 20, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-82-1 through -3

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The National Transportation Safety Board has completed its investigation of an in-flight accident involving a World Airways, Inc. DC-10-30 aircraft en route from Baltimore-Washington International Airport, U.S.A., to Gatwick International Airport, U.K., on September 19, 1981.

Evidence indicates that a flight attendant was leaning over and probably attempting to remove a service cart from the personnel lift in the lower galley when the lift started moving upward. The flight attendant became trapped between the top of the service cart in the galley personnel lift and the ceiling of the lower galley and as a result sustained fatal injuries.

On the basis of preliminary information, the Safety Board issued four (4) safety recommendations, A-81-124 through -127. As the investigation continued, additional safety hazards were identified which are discussed herein. 1/

### Cart Retention Devices

Interviews with World Airways flight attendants and discussions with flight attendant associations revealed a serious problem with the cart retention system in the lifts. Numerous comments were received complaining of difficulties in releasing service carts from the restraining spool (mushroom) which is attached to the floor of both the personnel and cart lifts. At least two (2) incidents (both documented in the World Airways accident report) have occurred which resulted in serious injuries to flight personnel while they were attempting to free stuck carts from these mushroom devices. The Safety Board believes that the method for assuring retention of the carts, particularly in galley lifts, should assure freedom from jamming and ease of release by flight attendants.

1/ For a more detailed discussion, read Aircraft Accident Report—"World Airways, Inc., DC-10-300F, N112WA, Over North Atlantic Ocean, September 20, 1981" (NTSB-AAR-82-1).

3876B

### Lift Command Switches

There are three control panels which contain the up/down/stop command switches. The panels are positioned one each in the lower (lobe) galley, the service center, and inside the personnel lift.

The design of the circuitry for the lift command switches in the DC-10 allows a hazardous situation to result if the switches are used improperly. Proper operation is similar to the operation of elevator switches; depress then release. When the up or down command switch is properly operated, then depression of the stop switch will stop movement of the lift. However, if either the up or down switch is held in the depressed position, then operation of the stop switch has no effect and the lift will continue to move. While it would be reasonable for flight attendants to assume that the "stop" switch would override any up or down command to facilitate an emergency stop, the circuitry does not provide this safeguard.

The lift controls on other aircraft were also examined. The L-1011 lift control system is very similar to the DC-10 except its stop switch has priority over the directional control switches regardless of whether these switches are held depressed or not. The B-747 has no stop switch; only directional switches and they must be depressed and held in to maintain movement of the lift. Some carriers operate both DC-10's and B-747's with flight attendants who are qualified on both aircraft. In that case, there is a particular potential for the improper operation of the command switches in the DC-10. The Board learned that at least one carrier, after recognizing the potential danger of the standard DC-10 lift control circuitry, engineered changes to accord the stop switch priority over all other command switches. The Board believes that a similar change must be made in all DC-10 aircraft.

### Lift Door Interlock Switches

There are two (2) door interlock switches per door which are designed to prevent operation of the lift with the door open. Each switch is wired into an independent drive circuit. Normally both circuits operate; however, if loss of electrical power occurs in one of the two circuits, the lift can continue to operate at half (or partial) speed thus allowing continuation of food service. However, the system is not properly safeguarded. Present circuitry will allow the lift to operate at half speed even if one interlock switch is in the unactivated (door open) position. The Board believes that a door open signal from any interlock switch should be sufficient to prevent operation of the lift.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require the replacement of the "mushroom" cart restraint devices in the personnel and cart lifts in the DC-10 aircraft galley lift system with a nonjamming cart restraint system. (Class II, Priority Action) (A-82-1)

Require the modification of the switch circuitry in the DC-10 aircraft galley lift system to accord the "Stop" switch function priority over all other control switch functions. (Class II, Priority Action) (A-82-2)

In addition to requiring the relocation of the personnel and cart lift door interlock switches in the DC-10 aircraft galley lift system (A-81-126), require modification of the interlock circuitry to preclude energizing the drive system motors until both interlock switches on each of the galley lift doors have been actuated. (Class II, Priority Action) (A-82-3)

KING, Chairman, and McADAMS, GOLDMAN, BURSLEY, and BURNETT, Members, concurred in these recommendations.

*Jim Burnett*  
*for*

By: James B. King  
Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: February 2, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591  
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SAFETY RECOMMENDATION(S)

A-82-4 and 5

On October 20, 1981, an Aerospatiale Lama 315B helicopter, N9531, experienced an in-flight power loss near Springville, Utah. The aircraft was substantially damaged during an attempted autorotation landing. The pilot and two of the four passengers sustained minor injuries.

The National Transportation Safety Board's investigation revealed that a failure had occurred in the helicopter's powertrain between the engine and the input to the main transmission in the area of the clutch coupling. Further investigation revealed that the failure had been caused by an engine-to-transmission misalignment, which occurred during maintenance just prior to the accident. An Aerospatiale Alouette 316B aft engine support frame had been installed instead of the correct frame for the Aerospatiale Lama 315B. Although the Alouette frame is seven-eighths of an inch shorter in height than the Lama frame, it is otherwise identical to the Lama frame at the engine and airframe attachment points.

Discussions with Aerospatiale personnel revealed that the part numbers for the two frames are different and that they are painted on the frames during manufacture rather than being permanently affixed. Subsequent customer painting options and an 800-hour periodic inspection, which requires paint stripping of the frame, soon destroy the part number identification.

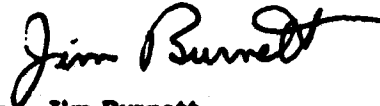
Because operators of the Lama 315B and Alouette 316B/C and 319 helicopters could inadvertently interchange the aft engine support frames, a safety hazard exists that should be eliminated. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue a Telet Maintenance Bulletin to notify operators and inspection personnel of the possibility of interchanging aft engine support frames of the Lama 315B and Alouette 316B/C and 319 helicopters and to recommend a dimensional check of the frame prior to installation even though the part number may be legible.  
(Class II, Priority Action) (A-82-4)

3441

Require the manufacturer to develop and implement a permanent method of affixing part numbers to the aft engine support frames on the Lama 315B and Alouette 316B/C and 319 helicopters. (Class III, Long Range) (A-82-5)

KING, Chairman, and McADAMS, GOLDMAN, BURSLEY, and BURNETT, Members, concurred in these recommendations.

A handwritten signature in cursive script that reads "Jim Burnett".

By: Jim Burnett  
Acting Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: January 28, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
800 Independence Avenue, S.W.  
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-82-6 through -15

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As a result of its continuing investigation of the crash of Air Florida Flight 90, a Boeing 737-222 (N62AP), about 1801 e.d.t. on January 13, 1982, the National Transportation Safety Board believes that immediate corrective action is needed in the area of cold-weather operations procedures. The aircraft had departed from runway 36 at Washington National Airport in moderate to heavy snowfall and low visibility. The aircraft failed to achieve a sufficient rate of climb, struck the 14th Street Bridge about 4,500 feet from the departure end of the runway, and crashed into the Potomac River. Seventy-four of the 79 persons aboard the aircraft were killed either on impact or by drowning, and 4 persons in automobiles on the bridge were killed when the vehicles were struck by the descending aircraft.

A weather observation taken within 15 minutes after the accident indicated that the visibility was 3/8 mile in snow, the temperature and dewpoint were both 24°, and the wind was from 020° at 13 knots. The evidence gathered to date shows that about 45 minutes had elapsed between the final deicing of the aircraft's aerodynamic surfaces with an ethylene glycol/water solution and the takeoff. During the 45-minute period, an additional 0.7 to 1.0 inch of snow had accumulated. Therefore, the Board's continuing investigation is focusing on, among other factors, those which could have affected the aircraft's takeoff and climb performance. These will include the effect of a runway contaminated by snow or slush on takeoff acceleration, the extent to which aerodynamic lift is degraded by contaminated airfoils, and the possible effects of engine nacelle and pressure probe icing.

In previous Safety Recommendations (A-80-112 through A-80-114), the Safety Board has expressed concern about the lack of knowledge of operators and flightcrews regarding the inability of deicing fluid to protect against icing from precipitation following deicing. We were pleased by the FAA's issuance of Air Carrier Operations Bulletin No. 7-81-1 and the proposed research and development study referenced in your February 11, 1981, letter to the Board. However, we now believe that more positive and immediate actions are needed to provide safe operations during the current winter months. Bulletin No. 7-81-1 advises principal inspectors to request operators to review their deicing and anti-icing procedures for

adequacy. The Safety Board does not believe that this approach has obtained the needed results. Rather, the FAA must actually review prescribed procedures and those actually used by all air carrier maintenance and dispatch personnel, and flightcrews who routinely conduct cold weather operations to assure (1) that they are provided with sufficient and accurate information regarding proper deicing procedures and (2) that they are alerted to misconceptions regarding the anti-icing effectiveness of these procedures.

Additionally, the Safety Board's review of a number of air carrier operations manuals indicates that some do not contain information regarding the potential degradation in takeoff acceleration which can result from snow, slush, or water on the runway. More significantly, all operators of similar model aircraft apparently do not have standard, optimum procedures regarding the use of engine anti-ice during ground operation and takeoff. The preliminary investigation of the Air Florida accident indicates that the engine anti-ice system was OFF at the time of impact, and the Safety Board has not yet determined whether the engine anti-ice system had been used during the pre-takeoff ground operation.

Without regard to whether the ground operations had been conducted using engine anti-ice, the Safety Board is concerned that ice accumulation on the JT8D engine inlet pressure probe (PT2) could have affected the function of the engine pressure ratio (EPR) indicator to the extent that the crew was presented with a false indication of takeoff thrust when the engine reached some lower thrust level. Recent discussion with another air carrier has recently disclosed that an abnormal number of takeoffs have been rejected by pilots of B-737 and B-727 aircraft because of problems with EPR indications during the recent cold weather. In all of these instances, pilots stated that both ground operations and the attempted takeoff were conducted with engine anti-ice ON and operating and in all cases the takeoff was rejected because the EPR indication failed to reach takeoff values. Preliminary discussions between our engineering staff, a representative of the engine manufacturer, and air carrier engineering personnel indicate that, with a blocked PT2 probe, the EPR indicator will give an indication that thrust is higher than actual with engine anti-ice OFF and that is lower than actual with anti-ice ON. Any inaccurate indication of thrust level presents the obvious hazard of a rejected takeoff on a slippery runway. However, an indication of higher than actual thrust can be even more hazardous if a pilot referencing the EPR gage for setting engine thrust attempts to accelerate and take off with insufficient thrust.

Most of these pilots stated that before they attempted takeoff, they had been required to taxi or hold behind other aircraft while awaiting takeoff clearance and that engine thrust levels sufficient for effective anti-icing could not be achieved because of the low coefficient of friction of the taxiway, runup pad, and runway surfaces. Icing problems may occur more often as a result of the more frequent ground delays being experienced during the rebuilding of the ATC system. Therefore, we believe that all flightcrews should be immediately alerted to the dangers of engine inlet pressure probe icing, the effect of anti-ice usage on erroneous thrust indications, the absolute requirement to cross-check all engine instruments during the application of takeoff power, and the importance and significance of the requirements of 14 CFR 121.629(b). 1/

1/ 14 CFR 121.629(b) states, "No person may takeoff an aircraft when frost, snow, or ice is adhering to the wings, control surfaces, or propellers of the aircraft."

We also believe that FAA tower and ground control personnel should be informed of the greater-than-normal icing potential which exists when an aircraft encounters lengthy ground delays and the potential for thawing and refreezing when an aircraft is required to taxi or hold near another aircraft's engine exhaust. Further, controllers should implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, Paragraph 1232. 2/

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Immediately notify all air carrier operators of the potential hazard associated with engine inlet pressure probe icing, and require that they provide flightcrews with information on how to recognize this hazard and requiring that flightcrews cross-check all engine instruments during the application of takeoff power. (Class I, Urgent Action) (A-82-6)

Immediately review the predeparture deicing procedures used by all air carrier operators engaged in cold weather operations and the information provided to flightcrews to emphasize the inability of deicing fluid to protect against reicing resulting from precipitation following deicing. (Class I, Urgent Action) (A-82-7)

Immediately review the information provided by air carrier operators to flightcrews engaged in cold weather operations to ensure comprehensive coverage of all aspects of such operations, including the effects of a runway contaminated by snow or slush on takeoff, and methods to be used to obtain maximum effectiveness of engine anti-ice during ground operations and takeoffs. (Class I, Urgent Action) (A-82-8)

Immediately require flightcrews to visually inspect wing surfaces before takeoff if snow or freezing precipitation is in progress and the time elapsed since either deicing or the last confirmation that surfaces were clear exceeds 20 minutes to ensure compliance with 14 CFR 121.629(b) which prohibits takeoff if frost, snow or ice is adhering to the wings or control surfaces. (Class I, Urgent Action) (A-82-9)

Immediately issue a General Notice (GENOT) to all FAA tower and air carrier ground control personnel alerting them to the increased potential for aircraft icing during long delays before takeoff and when aircraft operate in proximity to each other during ground operations in inclement weather, and encouraging procedural changes where possible so that the controllers implement the gate-hold provisions of the Facilities Operations and Administration Manual 7210.3F, paragraph 1232. (Class I, Urgent Action) (A-82-10)

Document the effect of engine inlet pressure probe blockage on engine instrument readings and require that such information be added to approved aircraft flight manuals. (Class II, Priority Action) (A-82-11)

2/ Paragraph 1232(a) states, "The objective of gate-hold procedures is to achieve departure delays of 5 minutes or less after engine start and taxi time...Implement gate-hold procedures whenever departure delays exceed or are expected to exceed 5 minutes.

-4-  
10-4  
Amend Advisory Circulars 91-126, "Cold Weather Operation of Aircraft," and 91-51, "Airplane Deice and Anti-ice Systems," to discuss in detail the effects and hazards associated with engine inlet pressure probe icing. (Class II, Priority Action) (A-82-12)

Revise the air traffic control procedures with respect to aircraft taxiing for takeoff, holding in line for takeoff, and taking off to provide for increased ground separation between aircraft whenever freezing weather conditions and attendant aircraft icing problems exist. (Class II, Priority Action) (A-82-13)

Expand the training curricula for air traffic controllers and trainees to assure that instruction includes the hazards associated with structural and engine icing of aircraft. (Class II Priority Action) (A-82-14)

Immediately disseminate the contents of this safety recommendation letter to foreign operators involved in cold weather operations. (Class I, Urgent Action) (A-82-15)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: Jim Burnett  
Acting Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: February 18, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
800 Independence Avenue, S.W.  
Washington, D.C. 20591  
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SAFETY RECOMMENDATION(S)

A-82-16

On July 1, 1981, a Douglas DC-6B, N8CA, ran off the side of the runway while landing at the Lambert-St. Louis International Airport. The crew of the cargo flight was extending the flaps for landing when the main hydraulic system failed. The pilot requested and received the longest runway for landing, runway 30R. During the landing roll, the pilot had neither nose wheel steering nor hydraulic brakes. The pilot attempted to use propeller reversing and differential power for brakes and directional control, but the aircraft veered to the right and rolled off the side of the runway. The aircraft nose wheel impacted a portion of the midfield arrestment barrier that is in place on runway 30R. None of the three persons aboard was injured. The aircraft damage was limited to the nosewheel.

The midfield arrestment barrier was supplied by the U.S. Air Force and was installed by the McDonnell Douglas Aircraft Corporation for use in its fighter aircraft production program. The portion of the arrestment barrier that was struck by N8CA protrudes above the ground level for at least 12 inches and is erected approximately 20 feet beyond the side of the runway, at the edge of an asphalt apron. A similar unit is located on the opposite side of the runway. For normal departures and arrivals, they pose no threat to safety. However, their presence in certain instances could prove detrimental not only from the standpoint of substantial damage to the aircraft but also, where passenger carrying operations are involved, to the loss of life or serious injuries to such passengers.

The Safety Board believes that the arrestment barrier as it is installed violates the intent of CFR 14, Part 139.45.

Therefore, in the interest of improving the safety of aircraft operating at the Lambert-St. Louis International Airport, the National Transportation Safety Board recommends that the Federal Aviation Administration:

3442

Eliminate the safety hazard created by the aboveground portions of the  
midfield arrestment barrier. (Class II, Priority Action) (A-82-16)

BURNETT, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members,  
concurred in this recommendation.



By: Jim Burnett  
Acting Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

**ISSUED: March 5, 1982**

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**Forwarded to:**

**Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591**

**SAFETY RECOMMENDATION(S)**

**A-82-17 through -23**

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On January 21, 1982, a Cessna Model P-210N, N4947K, crashed in instrument meteorological conditions, near Boise, Idaho. All four persons aboard the aircraft were killed. About 20 minutes after departing Boise, the pilot had indicated to the air traffic controller that he was "losing his gyros," and requested assistance in returning to Boise. Shortly thereafter, the aircraft broke up in flight. Examination of the pressure/vacuum pump revealed that the (frangible) plastic drive shaft had sheared.

On November 20, 1981, a Cessna Model T-210N, N4823C, crashed at Charleston, West Virginia. All three persons aboard, including two instrument rated pilots, were killed. After indicating that he had experienced a complete loss of vacuum, the pilot had operated the aircraft in the emergency partial panel mode for about 20 minutes. However, during an attempted instrument landing system (ILS) approach, the aircraft struck a ridge at a steep angle of bank. Examination of the pressure/vacuum pump disclosed a sheared drive shaft.

On September 25, 1981, a Cessna Model T-210L, N94136, crashed at Big Timber, Montana, while on an instrument flight rules (IFR) flight plan; the pilot was killed. The aircraft was above the clouds at 19,000 feet when it was cleared to descend to 13,000 feet. The pilot lost control of the aircraft shortly after entering the clouds and the aircraft broke up in flight. The investigation disclosed that the pressure/vacuum pump shaft had sheared.

On February 22, 1981, a Mooney Model M20F, N1919T, crashed at Montgomery Township, New Jersey; all four persons aboard were killed. The aircraft was on an IFR flight plan from Hilton Head, South Carolina, to Teterboro, New Jersey. Shortly before the accident, the aircraft had been flying above the clouds when the pilot reported a vacuum malfunction and inoperative attitude and directional gyros. The pilot continued to fly toward his planned destination and was subsequently cleared to descend into the clouds. Shortly thereafter, the aircraft crashed in a steep, high speed, nose down attitude.

**3463**

On December 2, 1980, a Cessna Model T-210N, N4846C, crashed at Tazewell, Tennessee, killing all four persons aboard. The aircraft had departed Peachtree City, Georgia, on an IFR flight plan to Mansfield, Ohio. When the aircraft was at 12,000 feet, the pilot had called the Atlanta Air Traffic Control Center, saying "46C has lost vacuum, I would like to have immediate clearance back to Knoxville." The pilot was cleared to proceed directly to Knoxville and to descend and maintain 8,000 feet. However, the pilot did not begin a descent until several minutes later, at which time the center asked if he needed special handling. The pilot declined and said "...everything's okay except for the vacuum." Shortly after entering the clouds, with tops at approximately 10,000 feet, the pilot lost control of the aircraft. An examination of the wreckage revealed that the right wing and empennage had separated in flight. The examination also disclosed that the drive shaft of the pressure/vacuum pump had failed for unknown reasons.

All the accidents involved spatial disorientation of instrument-rated pilots who attempted to control and maneuver their aircraft in clouds without operative attitude and directional gyros. Most general aviation single engine aircraft are not equipped with gyro instrument redundancy, other than the turn indicator, in the event of failure of the primary gyro instruments or the pressure/vacuum pump. At least four of the pilots recognized a vacuum system malfunction and were attempting to use emergency partial panel procedures (the electric turn indicator, the inclinometer, and the pitot-static instruments, i.e., airspeed indicator, altimeter, and vertical speed indicator) when the aircraft crashed. Three of the Cessna Model 210 aircraft were equipped with pneumatic deicer boots.

Although FAR 61.65(c)(5), "Instrument Rating Requirements," requires that pilots demonstrate competence in handling simulated emergencies involving equipment or instrument malfunctions, none of the accident pilots was prepared to cope with actual emergencies when encountered under instrument meteorological conditions. Moreover, there are no requirements under the regulation relating to partial panel navigation, maneuvering, or approaches — all critical operational tasks and one or another of which was involved in the above accidents. While the maintenance of straight and level flight using partial panel is practiced routinely during initial instrument instruction and certification, the Safety Board believes that insufficient emphasis is placed on the aforementioned critical tasks when instructional instrument approaches to minimum altitudes are conducted. Consequently, the Safety Board believes that specification of such partial panel operations in FAR 61.65(c)(5) is essential.

The Safety Board believes that pilots generally do not maintain an adequate level of partial panel proficiency subsequent to receiving their instrument rating, but rather tend to become overly reliant on the use of the attitude gyro. However, a review of the small aircraft malfunction/defect report data from the Federal Aviation Administration's (FAA) Maintenance Analysis Center indicates that such overreliance on this vacuum pump-dependent instrument is not justified. Between January 1, 1978, and February 15, 1981, at least 325 pressure/vacuum pumps produced by the Airborne Manufacturing Company and the Edo-Aire Manufacturing Company (the only companies currently producing such pumps) failed for unknown reasons. According to comments accompanying the data, e.g., "Shaft sheared at 126 hours, ...shaft sheared after 15 hours of operation, ...pump locked up and sheared drive at 129 hours, ...pump failed after 5 hours of operation," some of the failures occurred prematurely. The actual number of pressure/vacuum pump failures is probably much larger than indicated since only a relatively small percentage of such failures or malfunctions are ever reported. (A report of this type of failure to the FAA is discretionary.) Therefore, the Safety Board believes that an engineering evaluation should be conducted to ascertain the design adequacy and reliability of these pumps and to determine the cause or causes for what appears to be an inordinate failure rate.

The FAA data suggest that failure of the pressure/vacuum pump is more likely in aircraft such as the Cessna Model 210N with deicing systems where a single high capacity pressure/vacuum pump is used for high-pressure, multipneumatic requirements. The pumps in these aircraft supply power to the gyro instruments, as well as the deicer boots. The mean time to failure of these pumps is reduced substantially because of higher operating pressures, altitudes, and cyclic loads. The Airborne Manufacturing Company, which produced the pumps installed in the Cessna Model 210N, warrants its high-capacity models for 400 hours and its lightweight, low-capacity pumps, like those in the Mooney Model M20F, for 1,000 hours. The low-capacity pump in the Mooney Model M20F supplies power to the gyro instruments, the retractable step, and a wing-leveling device. Similar pumps installed in other aircraft supply power only to the gyro instruments.

The Safety Board has become increasingly concerned regarding the propensity for failure of pressure/vacuum pumps in Cessna Model 210N aircraft equipped with deicing systems. The Model 210 aircraft were certificated for flight in known icing conditions in 1979 after Cessna developed a complete deicing package for the series N aircraft (pneumatic deicing boots, windshield heat, stall warning heater, etc.). Cessna has installed pneumatic boots on previous Model 210 series aircraft, but only on a no-hazard basis, i.e., that the installation has no significant effect on aircraft operation or safety. The configuration of these boots, as well as the boot cycling schedule, differs markedly from that on Model 210N aircraft. The demands of the new 3-cycle, split-boot deicing system for series N aircraft may have significantly affected the reliability of the pressure/vacuum pump. Therefore, the Safety Board believes that the FAA should conduct a design certification review of the pneumatic portion of the system.

Currently, dual vacuum pumps are installed as standard equipment on all 1982 Cessna Model 210 aircraft with deicing systems. One of the pumps provides a separate, independent source of vacuum for the gyro flight instruments and the other powers the deicing system. The dual pumps are offered as an option on all other 1982 model 210's and should be available by February 15, 1982, for installation on 1978-1981 model 210's. The Safety Board believes that an Emergency Airworthiness Directive should be issued requiring installation of these dual pumps on all Cessna Model 210N aircraft with deicer boots as a requirement for flight into known instrument meteorological conditions.

In addition, turbocharged aircraft, such as the Cessna Model T-210L, which utilize Airborne's low-capacity model 212-cw pump, can operate routinely at relatively high altitude. Since the pump has to work harder at high altitudes, it becomes hotter, thus, increasing the potential for internal binding or seizure and consequent failure. Because of this and other adverse effects on pump life, the Airborne Manufacturing Company recommends that vacuum application of the model 212-cw pump be limited to maximum operating cruise altitudes of 15,000 feet or less. The Safety Board believes that aircraft system designers should consider the use of positive pump pressure for gyros that will operate above this altitude or the use of a larger, finned vacuum pump with appropriate provisions for cooling.

On March 26, 1976, the Safety Board recommended that the Federal Aviation Administration issue an Advisory Circular to inform pilots of: (1) procedures they should use to determine the operability of gyroscopic instruments, (2) the importance of instrument crosschecks during IFR flight, and (3) the importance of staying proficient in partial-panel emergency operation. (Safety Recommendation No. A-76-30.) The FAA responded by issuing Advisory Circular (AC) 91-46, "Gyroscopic Instruments—Good Operating Practices."

AC 91-46 directed pilots to include the vacuum gauge and ammeter/load meters in their instrument crosscheck to assure early detection of a malfunctioning instrument system power source and to be prepared to transition immediately to partial panel operation if necessary. Because an undetected failure of the vacuum pump may have been a critical factor in the Montana accident on September 25, 1981, the Safety Board believes that any general upgrading of instrument rating requirements should, in accordance with AC 91-46, place additional emphasis on the detection of failures of the pressure/vacuum system.

Because accidents involving loss of control during emergency partial panel operations are characteristically fatal as evidenced by the five accidents cited, the Safety Board believes that a special effort is warranted to reduce the numbers of such accidents. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Emergency Airworthiness Directive specifying the installation of the dual vacuum pump accessory kit in all Cessna Model 210N aircraft equipped with deicer boots as a requirement for flight into known instrument meteorological conditions. (Class I, Urgent Action) (A-82-17)

Conduct a design certification review of the pneumatic portion of the deicing system in Cessna Model 210N aircraft and take appropriate remedial measures to improve system reliability. (Class II, Priority Action) (A-82-18)

Amend FAR 61.65(c)(5), "Instrument Rating Requirements," to make simulated emergency operations on partial panel more rigorous and specific, and to include the detection of failures of the pressure/vacuum or flight instrument system, and navigation/maneuvering/approach techniques. (Class II, Priority Action) (A-82-19)

Amend FAR 61.57(e), "Recent Flight Experience: Pilot In Command," to require experience during the preceding 24 months in instrument approaches using partial panel techniques as a prerequisite to exercising instrument privileges in aircraft which do not have redundant or dual, independently powered gyro systems. (Class II, Priority Action) (A-82-20)

Conduct an engineering evaluation to determine the failure mode and design adequacy of aircraft vacuum pumps produced by the Airborne Manufacturing Company and the Edo-Aire Manufacturing Company. (Class II, Priority Action) (A-82-21)

Require, in subsequent certification of all single-engine airplanes equipped with pneumatic deicing equipment, cabin pressurization, or autopilots, that aircraft attitude and direction indicators be operated independently by a separate pressure/vacuum pump or other source of power. (Class II, Priority Action) (A-82-22)

Conduct an engineering evaluation of the effect of high altitude operations on the life and reliability of light weight, low-capacity vacuum pumps in turbocharged aircraft. (Class II, Priority Action) (A-82-23)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: Jim Burnett  
Acting Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

**ISSUED: March 5, 1982**

-----  
**Forwarded to:**

**Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20591**

**SAFETY RECOMMENDATION(S)**

**A-82-24 and -25**

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About 0634 Pacific daylight time, May 2, 1980, a McDonnell Douglas Corporation DC-9-80, N980DC, was damaged substantially during a landing on runway 22 at Edwards Air Force Base, California. The accident occurred during a landing in which the flightcrew was using procedures established for the official certification test to determine the horizontal distance required to land and bring the airplane to a full stop as required by 14 CFR 25.125.

The airplane touched down about 2,298 feet beyond the runway threshold. The descent rate at touchdown exceeded the structural limits of the airplane; the empennage separated and fell to the runway. The airplane came to rest about 5,634 feet beyond the landing threshold. Seven crewmembers were on board; one crewmember, a flight test engineer, suffered a broken ankle when the airplane touched down.

The National Transportation Safety Board determined that the probable cause of this accident was the pilot's failure to stabilize the approach as prescribed by the manufacturer's flight test procedures. Contributing to the cause of the accident was the lack of a requirement in the flight test procedures for other flight crewmembers to monitor and call out the critical flight parameters. Also contributing to this accident were the flight test procedures prescribed by the manufacturer for demonstrating the aircraft's landing performance which involved vertical descent rates approaching the design load limits of the aircraft.

Basically, the certification requirements in 14 CFR 25, and more particularly sections 25.101 and 25.125, relate to the determination of horizontal landing distances which are then used in conjunction with the appropriate operational requirements of 14 CFR 121.195 to determine the maximum weight at which the airplane can be landed during air carrier operations for a given runway length. Sections 25.101 and 25.125 specifically state that the procedures established for the certification tests must be able to be consistently executed.

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average skill; that the methods used must be safe and reliable; that the landing must be made without excessive vertical acceleration; and that the landing may not require exceptional piloting skill or alertness. The Safety Board believes that these requirements, as stated, may be too subjective. All of the airframe manufacturers have established procedures in the context of these regulations which involve a minimum air distance from a point 50 feet above the runway threshold and a touchdown speed below  $V_{ref}$  to produce a minimum rollout distance.

It is understandable that the manufacturers will attempt to demonstrate the shortest landing distance possible and thus maximize the operational specifications of their aircraft. However, the Safety Board notes that the procedures specified and used for these certification tests differ from those used during normal line operations. For example, the procedures established for demonstration of the DC-9-80 landing distances specified that thrust be reduced to idle at 50 feet above ground level and that the rate of descent be reduced to no more than 10 feet per second (600 fpm) or no less than 8 feet per second (480 fpm) at touchdown. Thus, the procedure not only allows but requires that the airplane be landed in such a manner that limit or near limit structural loads (as specified in 14 CFR 25.473) are imposed. The procedures also require skill and precise actions by the test pilots as evidenced by the admitted need to practice before undertaking official tests.

The certification tests for demonstrating airplane structural limits (such as 14 CFR 25.473) are conducted separate from the landing distance tests of 14 CFR 25.125 since these tests have entirely different objectives. There are considerable risks involved in taking an airplane to its structural limits during the landing distance demonstration. Furthermore, it is not necessary to do so when the test objective is to determine operational landing distances.

The Safety Board further notes that another accident occurred on May 14, 1959, when similar procedures were being used to demonstrate the minimum landing distance of the DC-8 airplane during its certification tests. In that instance, the airplane also touched down at an excessive descent rate which resulted in structural failure of the fuselage and separation of the No. 1 engine.

These two accidents indicate that, under current regulations, procedures are being used during certification which are not consistent with line operations so that the distances determined during certification are not actually achievable by a line pilot using accepted operational procedures. Accordingly, the Safety Board believes that this aspect of the certification process should be revised. Section 25.125 should be more specific in terms of approach path deviations, thrust reduction schedules, and maximum allowable vertical acceleration at touchdown. For example, landings equivalent to those resulting from ILS approaches or equivalent to the performance attainable from an autoland system could be established.


The Safety Board recognizes that changes in the landing distance demonstration procedures during certification could result in penalizing the operational specifications of the airplane as they are presently determined using the existing minimum landing distance procedures. For actual line operations on dry runways, a safety margin is currently provided by the operational limitation of 14 CFR 121.195 which requires that the minimum effective runway length be the airplane's landing distance as determined during certification divided by 0.6 (or multiplied by 1.667). The Safety Board's accident investigation experience has not indicated to date that the actual runway lengths used in line operations for dry runways do not afford a proper level of safety. Therefore, the Safety Board recognizes that a change in the aircraft certification criteria specified in 14 CFR 25.101 and 25.125 will necessitate a corresponding review of the operational limitations in 14 CFR 121.195 so that operational specifications are not unjustifiably penalized. Of course, we are not suggesting that current runway length requirements be compromised to the detriment of present levels of safety.

Accordingly, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Revise the procedures which are currently being used to demonstrate minimum landing distances for compliance with 14 CFR 25.125 for certification of transport category airplanes to: (a) provide a higher margin of safety during certification and (b) establish landing distances which are more representative of those encountered when an airplane is operated during air carrier service. (Class II, Priority Action) (A-82-24)

Upon adoption of revised procedures for demonstrating operational landing distances for compliance with 14 CFR 25.125, review the operational runway length limitations in 14 CFR 121.195 which are applied to certification landing distances so that they do not unjustifiably penalize the operational specifications of airplanes. (Class II, Priority Action) (A-82-25)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: Jim Burnett  
Acting Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: March 11, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591  
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**SAFETY RECOMMENDATION(S)**

A-82-26

On September 5, 1981, a Piper aircraft model PA-25, N86336, was involved in a fatal accident about 7 miles southwest of Sandston, Virginia. Investigation of the accident disclosed that the left wing separated in flight when the front spar fractured. Detailed metallurgical examination of the front spar fracture disclosed that a fatigue crack had occurred through approximately 90 percent of the fractured cross sectional area of the front spar. (See attached Metallurgical Laboratory Report No. 82-17.) The fatigue cracking originated in an area of the 6061-T6 aluminum alloy spar that had been welded, apparently in an attempt to repair previous damage to the spar.


On October 18, 1973, at Post, Texas, a PA-25-235, N4990Y, crashed as a result of an in-flight wing separation. Metallurgical examination of the front spar showed that the spar had failed as a result of extensive fatigue cracking originating in an area of an unauthorized spar repair. (See attached Metallurgical Laboratory Report No. 74-36.) The area of the repair had been softened by heat and weakened to approximately half of its original tensile strength.

The Safety Board is concerned that these accidents may indicate a possible widespread lack of appreciation for the potential effect of a repair of an aircraft structural element on the stress-carrying and fatigue properties of that element by general aviation repair personnel. The Board believes that the FAA should take action to inform operators of the consequences of unauthorized repairs.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue a General Aviation Airworthiness Alert (Advisory Circular No. 43-16) highlighting the aforementioned accidents to emphasize the importance of following established repair procedures, especially on major structural items such as wing spars. The Airworthiness Alert should reiterate the importance of not subjecting critical heat-treated aluminum alloy parts to extensive heat by welding or any other means for any reason, since heat will produce locally a change in internal microstructure which is detrimental to mechanical and fatigue properties. (Class II, Priority Action) (A-82-26)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members,  
concurred in this recommendation.

A handwritten signature in cursive script that reads "Jim Burnett". The signature is written in dark ink and is positioned above the typed name.

By: Jim Burnett  
Acting Chairman

Attachments (FAA only)

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

ISSUED: March 25, 1982

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Forwarded to:

Honorable J. Lynn Helms  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591  
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SAFETY RECOMMENDATION(S)

A-82-27 through -29

On July 16, 1981, a Piper PA-28-140 Cherokee Cruiser, N56731, crashed at Palm Bay City, Florida, killing the pilot and seriously injuring the other person aboard. The pilot-in-command was a commercial flight instructor employed by the Florida Institute of Technology (FIT) at Melbourne, Florida. He was accompanied by an FIT trainee (a commercial pilot) who was being given instruction in spins and other maneuvers in accordance with FIT's FAA-approved (14 CFR Part 141) Flight Instructor Airplane Course.

After departing Melbourne Airport, one of the pilots aboard the accident aircraft advised Patrick Air Force Base Approach Control that they would be practicing spins about 6 miles southwest of Melbourne between 2,000 and 4,500 feet msl. Shortly thereafter, one of the pilots said, "It still won't come out. Mayday. Mayday." Witnesses observed the aircraft spinning nearly straight down before impacting the ground.

The Piper PA-28-140 is certificated for operations in both normal and utility categories. Spins and certain other aerobatic maneuvers are permitted only when the aircraft is configured in the utility category which requires that gross weight and center of gravity not exceed 1,950 pounds and 86.5 inches aft of a specified datum, respectively. The Safety Board's investigation disclosed that, at the time of the accident, the aircraft gross weight was about 1,902 pounds and the center of gravity was approximately 87.0 inches aft of the datum. According to information from the Piper Aircraft Corporation, it is hazardous to conduct spins in the aircraft even when the utility-category aft center of gravity limit is only slightly exceeded.

The investigation revealed that upon departing Melbourne the aircraft contained about 37 gallons of fuel, and at the time of the accident approximately 33 gallons remained. If this aircraft had been dispatched properly for utility operation, a correct weight and balance determination would have disclosed that the maximum allowable fuel load was about 21 gallons. The aircraft's gross weight under these conditions would have been approximately 1,831 pounds, and the center of gravity would then have been at the utility category aft limit of 86.5 inches.

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On July 18, 1977, another Piper Cherokee PA-28-140, N6899J, on a 14 CFR Part 141 flight, was involved in an accident at Wadsworth, Illinois, similar to the accident involving N56731. The pilot-in-command of N6899J, a highly experienced flight instructor, and a flight instructor trainee were killed when the airplane crashed after they apparently were unable to recover from an intentional spin. The gross weight at the time of the accident was 1,941 pounds and the fuel load and center of gravity were estimated at 32 gallons and 86.8 inches aft of the datum, respectively—values almost identical to those estimated for N56731.

Since the front seats of Piper PA-28-140 aircraft are located near the airplane's empty-weight center of gravity, pilot or front passenger weight has only a slight effect on the airplane's loaded center of gravity position. Fuel, which is located further aft, has a greater effect and, for the utility category configuration, is the primary variable affecting the center of gravity. Moreover, the range of the utility category center of gravity envelope (at 1,950 pounds) is only 0.7 inch compared to the 10.1-inch normal category envelope. The criticality of fuel loading on utility category operations is not specifically addressed in Piper PA-28-140 Pilot Handbooks or flight manuals, and the pilots of N56731 and N6899J apparently did not know or fully appreciate this important relationship.

In view of the above accidents, the Safety Board believes that Piper PA-28-140 owner/operators should be provided additional detailed precautionary information regarding spins. The Piper Aircraft Corporation should specify in applicable aircraft pilot handbooks and flight manuals the criticality of fuel loading on airplane center of gravity and the maximum permissible or recommended fuel loads in typical spin training situations such as those involving N56731 and N6899J.

Some aircraft manufacturers have, for several years, recommended minimum spin initiation and recovery altitudes. For example, the Pilots Operating Handbook for the Cessna Model A150M recommends that six-turn spins be initiated at no less than 6,000 feet above ground level and that recoveries be completed at 4,000 feet or more above ground level. These criteria provide a margin of safety in the event of recovery difficulties due to confusion, apprehension, operational or mechanical anomalies, or improper application of spin recovery controls. In addition, a greater field of view is available to assist in maintaining pilot orientation. The Safety Board agrees with these procedures and believes that a minimum spin initiation altitude of 6,000 feet should be incorporated in all 14 CFR Part 141 flight training programs.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Review, and revise as necessary, the flight training curricula of the Florida Institute of Technology and other 14 CFR Part 141 pilot schools to assure that proper safety procedures and practices relative to utility category flight operations are in effect. (Class II, Priority Action) (A-82-27)

Require Piper Aircraft Corporation to supplement Piper PA-28-140 pilot handbooks and flight manuals by providing additional detailed precautionary information regarding spins. This information should include the criticality of fuel loading on airplane center of gravity and the maximum permissible or recommended fuel loads in typical spin training situations. (Class II, Priority Action) (A-82-28)

Require that spins conducted under a 14 CFR Part 141 training program be initiated at no less than 8,000 feet above ground level. (Class II, Priority Action) (A-82-29)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: Jim Burnett  
Acting Chairman

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